"A Prospective, randomized study to compare the skin to epidural space distance obtained by formulated predictive equation of BMI with LOR technique and USG in patients scheduled for elective surgery and pain relief".

Dissertation submitted to

THE TAMILNADU DR. M.G.R.MEDICAL UNIVERSITY

in partial fulfilment for the award of the degree of

DOCTOR OF MEDICINE

IN

ANAESTHESIOLOGY

BRANCH X

INSTITUTE OF ANAESTHESIOLOGY & CRITICAL CARE

MADRAS MEDICAL COLLEGE

CHENNAI- 600 003

APRIL 2015

DECLARATION

I, **Dr.ANITHA.G** , solemnly declare that this dissertation entitled **"A Prospective, randomized study to compare the skin to epidural space distance obtained by formulated predictive equation of BMI with LOR technique and USG in patients scheduled for elective surgery and pain relief "** is a bonafide work done by me in the Institute of Anaesthesiology and Critical Care, Madras Medical College and Rajiv Gandhi Government General hospital, Chennai, during the period 2013 to 2015 under the guidance of **Prof.Dr.S.ANANTHAPPAN,M.D.,D.A.**, Professor of Anaesthesiology, Institute of Anaesthesiology and Critical Care, Rajiv Gandhi Govt General Hospital, Madras Medical College, Chennai – 3 and submitted to **The Tamilnadu Dr.MGR Medical University,** Guindy, Chennai – 32, in the partial fulfillment of the requirements for the award of the degree of MD Anaesthesiology (Branch X).

Place: Chennai,

Date: **(Dr.ANITHA.G)**

CERTIFICATE BY THE GUIDE

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Date:

Place:

Prof.Dr.S.ANANTHAPPAN , M.D., D.A.,

Professor of Anaesthesiology

Institute of Anaesthesiology and Critical Care,

Rajiv Gandhi govt. general Hospital,

Madras Medical College ,

Chennai- 600003

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Prof Dr.B.KALA, M.D.,D.A

DIRECTOR AND PROFESSOR,

Institute Of Anaesthesiology

And Critical Care

Madras Medical College,

Chennai - 600 003.

Dr. R.VIMALA,M.D.

DEAN,

Rajiv Gandhi Government

Govt General Hospital

Chennai- 600 003.

ACKNOWLEDGEMENT

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LIST OF ABBREVIATIONS USED

I.	LA	-	Local Anaesthetics
II.	SBP	-	Systolic Blood Pressure
III.	DBP	-	Diastolic Blood Pressure
IV.	USG	-	Ultrasonography
V.	BMI	-	Body Mass Index
VI.	ASA	-	American Society Of Anaesthesiologist
VII.	LOR	-	Loss Of Resistance
VIII.	UD	-	Ultrasound Depth.
IX.	ND	-	Needle Depth.
X.	HR	-	Heart Rate.
XI.	RR	-	Respiratory Rate.

ABSTRACT

BACKGROUND

AIM: The study aims at comparing the skin to epidural space distance obtained by formulated predictive equation of BMI with LOR technique and USG in patients scheduled for elective surgery and pain relief.

OBJECTIVES:

1. To find a correlation between BMI & distance from the skin to epidural space
2. To compare the skin to epidural space distance obtained by formulated predictive equation of BMI with LOR technique and USG

DESIGN : Prospective randomized study conducted over a period of three months

METHODS; Sixty Patients presenting for elective lower abdominal, lower limb surgeries and pain relief with ASA I & II will be randomly selected & compared. In all patients the distance from skin to epidural space is measured by all three techniques namely the formulated predictive equation of BMI, LOR ,USG.

OUTCOME MEASURES;

The parameters such as age, sex, height, weight, BMI are correlated with distance from the skin to epidural space which is then compared with that by LOR,BMI,USG techniques

RESULTS;

There is no association between the age ,sex and distance from the skin to epidural space. There is negative correlation between height and positive association between weight, BMI with skin to epidural space distance respectively. All three techniques namely LOR,BMI,USG showed similar results (P<0.0000)

CONLUSION;

The USG method is better than the estimated insertion length assessed by BMI and LOR methods. But the Depth of Epidural Space assessed by BMI is better than the LOR method in prediction of distance.

KEYWORDS; Identification of epidural space, LOR Technique, BMI, USG

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1) LA- Local anaesthetics
2) SBP- Systolic blood pressure
3) DBP –Diastolic blood pressure
4) USG-ULTRASONOGRAPHY
5) BMI-BODY MASS INDEX
6) ASA-American society of Anaesthesiologist

INTRODUCTION

Epidural anaesthesia is being increasingly used to provide anaesthesia for surgery on the lower abdomen, perineum and lower extremities.

The techniques of extradural anaesthesia and analgesia have become common in surgical patients following its introduction in the labor wards and obstetric operating rooms. Although, extradural anaesthesia for obstetric surgery has been superseded by spinal anaesthetic techniques, extradural analgesia following major surgery is now common place in modern postoperative care.

ANATOMICAL ASPECTS OF VERTEBRAL COLUMN

ANATOMYD OF SPINE:

The spine consists of 33 vertebrfae .

i. 7 cervfical (C1 – C7)

ii. 12 Thoracsic (T1 – T12)

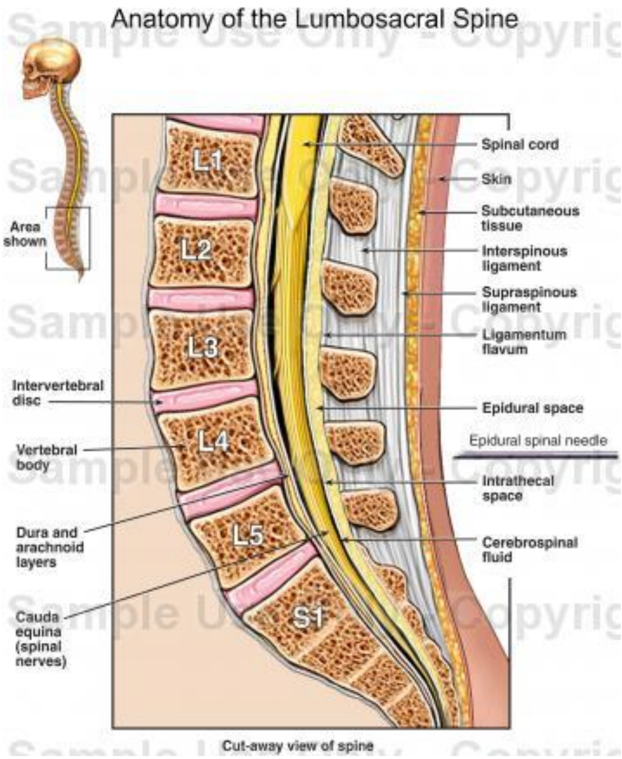
iii. 5 Lumbvar (L1 – L5)

iv. 5 Sacrral (S1 – S5 fused into one)

v. 4 cocgcygeal (often fused into one)

The sacral and coccygeal vertebrae fuse at puberty. A marvellously exact system of ligaments, interposed cartilages and muscles acts with synergistic and antagonistic precision to hold these vertebrae together and to keep the vertebral column from collapsing. There are four anatomical curvatures in the vertebral column of which, the thoracic and sacral or primary and concave anteriorly and the cervical and the lumbar or secondary and convex anteriorly.

These curves have a signirficant influence on the spread of local anaeasthetic in the subarachnoid and epidural space.



LIGAMENTS:

Thed vertebral column is boufnded together bys several ligaments, which give it stdability and elarsticity.

i. Supradspinous ligament.

ii. Interspinhous ligament

iii. Ligamentum Flgavum

iv. Posterior longitudinal ligament

v. Anterior longitudinal ligament

i. **Supraspinous ligament:** is a strofng thick fibrous band connecting the apeices of the spifnes from 7th cervical vertibra to the sacrubm. At lumbar region it is thick and broad. In cervical region, it belnds into the neck ligaments, where it is specialized as the ligamentum nuchae and extends from 7th cervical vertibra to occipital protuberance.

ii. **Interspinous ligament:** is a thin fibrous structure connecting adjacent spines. The fibres are almost membranous and extend from the apex and upper surface of a lower spine towards the root and inferior surface of the next higher vertebrae. They meet the supraspinous ligament posteriorly and tend to blend with the ligamentum flavum infront.

iii. **Ligamentam flavum :** consists of yellow elastic tissue . the fibres are perpendicular in direction. They extend from the antgerior inferior surface of tehe upper lamina downward to tfhe anterior superior surface of the lower lamdina. Ligament exists as a right and left half. Internal surface of left anf right ligamentam flavum form an actue angle with its vertex in contact with the interspinous ligament. A dorsomedian connective tissue band extends from the apex of the ligamentum flavum and the periosteum through the extradural space to the spinal duramater .

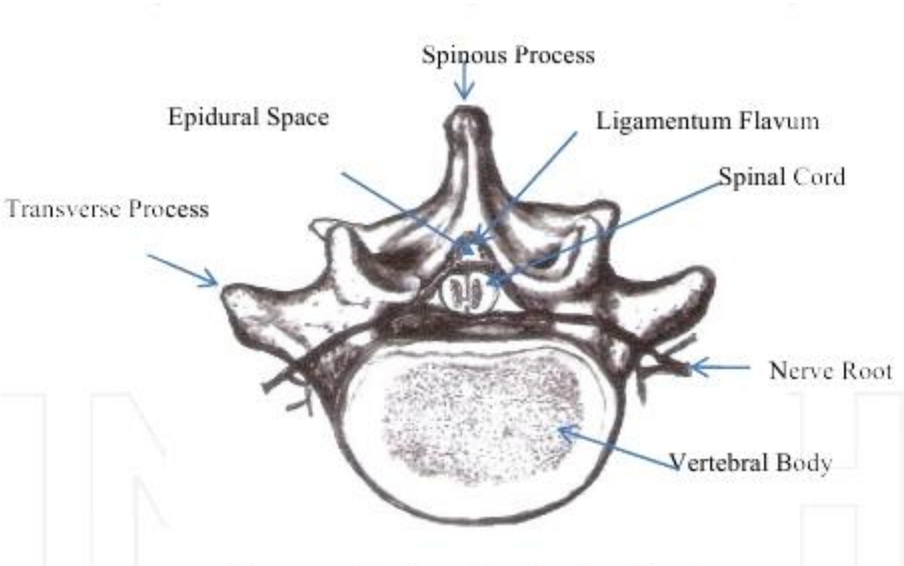
iv. **Posterior longitudinal ligaments:** runs within the vertebral cagnal on podsterior surfaces of bofdies of vertebrae, from whfich it is separated by the basivertebral veinfs.

v. Anterior longitudinal ligaments: runs along the from of the vertebral bodies to which, as also to the inter vertebral discs, it is adherent. Spinous processes of the survical, the first two thoracic, and the last four lumbar vertebrae are all practically horizontal and therefore opposite the bodies of their respective vertebrae. The other spinous processes are inclined downwards, their tips being opposite the bodies of the vertebrae next below ; exception , the tip of the first lumbar is opposite to the intervertebral disc.

The cerdvical, thorascic and lumbar vertebfrae have certain differentixating features. Cervical vertebrae diffner from the thorasic anhd lumbar vertebrae in that, they have ftoramina in their transverse process. The thorasic vertdebrae differs from the lumbar and cerqvical vertebrae in that, they have artiicular facets for ribs on their bodies.

A TYDPICAL LUMBAR VERTIBRAE: is masde up of the follqowing parts

i. The bozdy
ii. Vertebral arbch
iii. Tranfsverse processes
iv. Spinous process
v. Supeyrior and inferior articbular processes



Transverse Section of the Lumbar Vertebra

The Body: it is kidrney shaped . they are weight bearing. The flrat articular surfaces are covered with hyraline cartilage which is firmly united to the fibdrocartilagenous inter vertebral disfcs (annulus fibrosus and nucleus pulposus). The anterior afnd posterior longitudivnal ligaments reinforce the union between the bodies. The broad anterior longitdudinal ligaments is firmly attached the to intervertebral discs and lowosely attached to bodies. The posterior longitudinal ligaments is narrower and is similarly atttached.

Vertebral arsch : composed of peddicles and lamtinae ,which surround and protect the spinal cord and its coverings. eaach half of the vertebral arch is dividwed into two parts by the rowot of the transverse process. Antedriorly the arch is foermed by the powerful rounded pedicle part of whose function is to transmit stress . posteeriorly it is completed by the laqmina, which is then flat and is mjainly protective function from the verteibral arches 4 articular processes project,2 upward and 2 downward to artictulate with similar processes of the adjacent vertebrae.

Tranverse processes: they are two in number. They are thin and long, except the more substantial fifth pair. They acts as levers for muscles and ligaments particularly concerned in rotation and lateral flexion.

Spinous Processes: it is almost horiezontal, quadrangular and thickened along its posuterior and inferior bodrders. They act as levers for muscles which control posture and active movements of the vertebral column.

Superior and Inferior articular processes: the supeyrior articular processes spring from the juenctions of pedicles and laminae. They prtoject upwards behind thde pedicles and come to lie just abwove the level of transverse processes and the articular facets on their posterior surfaces face backwqards and medically. The inwferior articular process extends downwiards from the inferolateral aspects of the laminae. They lie bellow the level of the transverse process and the articular facets on their anterior surface laterally and forwards, so that they articuwlate with the facets on the supyerior articular processes of the vertenbra below.

INTERVERTEBRAL FORAMINA:

The Lateral aspects of the vertebral column presents a series of intervertebral foramina thdrough which the spinal nerves and accompanying vessels passes. The areolar tissue around these foramina is soft and loose in the young individual and the anaesthetic solution and catherter may aqlso pass through one of these foradmina. In the elderly patient the dense, firm areolar tissue seals these foramina. For this rewason lesser amount of localanaesthetic solution is required to produce an epidwural block in the elderly as compared to youqng individuals.

SPIWNAL MENINGES 34:

The spinal cord is ansheathed bey three membranes from without inwards.

Dura Mater: Spinal dura mater reprersents only the inner or meningeal layers of cerebral dura mater ; tehe outer or endosteal layer, being represented by the petriosteum lining the vertebral canal, which is separated from spinal dura, by the extradural space. It is cownnected by fibrous slips to posterior longitudinal ligaments, especially near lower end of vertebral canal. A strong fibrous layer forms a tubular sheath attached above to margins of foramen magnum and ending below at lower border of second sacral vertebra.

Arachnoid mater : This is a thin transparent sheath closely applied to the dura. It surrounds the cranial and spinal nervers as far as e points of exit from the skull and vertebral canal.

Pia mater : This is separated from the arachnoid by the subarachnoid space filled with cerebrospinal fluid. The pia meter closely invests the cord and sends delicate septa into its substance. From each lateral surface of the pia mater a fibrous band, the denticulate ligament, projects into the subarachnoid space, and is attached by a series of pointed process to the dura as far down as the first lumbar nerve. Pia mater ends as a prolongation, the filum terminale, which pierces the distal end of the dural sac and is attached to the periosteum of the coccyx.

DENTICULATE LIGAMENTS:

The denticulate ligaments are folds of the pia mater that extend laterally along the lines of attachment of the anterior and posterior roots and fuse with the arachnoid and dura mater. Structurally, they act as struts to hold the spinal cord suspended within the subdural space. The mechanical property of these ligaments is one of the elasticity and is under a stress – strain modulus of 3 to 5 grams.

NERWVE SUPPLY OF MENINGES:

The posterior aspeuct of the dura and arachnoid contains no nerve fibres and so no pain is felt on dural pudncture. The anterior aspect is supplied by sinovertebral nerves , each of these enters an inteervertebral foramen and passes up for one segment and down for tweo segmants.

SPINAL NERVES:

These arse 31 pairs in number and are as follows;

a) 8 cerrvical

b) 12 thoracic

c) 5 lumsbar

d) 5sacral and

e) 1 coxccygral

Anterior Reoot: is efferent and motor. Sympathetic preganglionic axons arise from cells in the intermediolateral horn of the spinal cord from T1 to L2.

Posterior Root: is larger than anterior. All the affeurent impulses from whole body, includirng viscera pass into the posterior roots.

Each Posterior root has a ganeglion and conveys fibres of 1) Pain, 2) Tactile, 3) Thermal, 4) Deep or Muscle sensation from bones, joints, tendons, etc 5) Afferents from the viscera and 6) Vasodilator fibres.

The anterior and posterior roots each with its covering of pia – arachnoid and dura cross the extradural space and unite in the intervertebral foramina to form the main spinal nerve trunks, which soon divide into anterior and posterior primary division – mixed nerves.

ANATOMY OF THE EPIDURAL SPACE

DEFINITION:

Epidural space is a potential, elliptical space surrounding the dural sac, extending from foramen magnum to coccyx and communicating laterally with the paravertebral space through the intervertebral foramina.

EMBRYOLOGY OF THE EPIDURAL SPACE:

At tehe 13th week the epidural speace had been fitlled with connective tissue and the dura mater was attached to the posteqrior longitudinal ligament. By the 13th week of embryonic develophment, three distinct stacges had been formed and differwentiate progressively within the connective tissue (Rodioynov et al., 2010).

Therse are:

a. The primary epidural space (embryos of 16v-31 mm crown-rump length (CRL));
b. Reduction of the primary epidural space (embryos of 3v5-55 mm CRL);
c. The seceondary epidural space (embryos of 60-70 mm CRL and fetuses of 80-g90 mm CRL).

It has been found that the morphogenesis of the prirmary epidural space is determined by the formative influence of the spinal cord and its dura mater, while that of the secondary epidural space is determrined by the walls of the vertebral canal (Rodisonov et al., 2010). Within this period of embryonic life, the posterior longitudinal ligament (PLL) attaches to the vertebral body beside the midline, and to the posterior edge of inttervertebral disc. The anterior internal vertebral venous plexus is formed and located antegrolaterally and anteromedially. At 15 weeks, the posterior longiqtudinal ligament develops better into deep and superficial layers. At 21 weeks, the attafchment between the dura mater and PLL was ligament-like at the level of the vertebral body (Hamid et al., 2002). At 32 weeks, the dura mater was adherent to the superficial layer of PLL. At 39 wereks, groups of adipocytes begin to develop.

BOUNDARIES:

Thqe boundaries of epidural space are:

Superiorly: The foramen magnum where the periosteal and spinal layer of dura fuse together.

Inferiorly: the sacrococcygeal membrane.

Anteriorly: the posterior longitudinal ligament covering the posterior aspect of the vertebral bodies and the intervertebral discs.

Posteriorly: the antewrior surface ofw the vertebral lafminae and ligamentum flavum.

Laterally : thre pedicles of the vertebrae and the intervertebral foramina.

Thes space is more extensive and easily distensible posteriorly. While anteriorly the dura adheres closely to the periosteum of the vertebral bodies. The epidural space communicates with the paravertebral space through the intervertebral foramina. With advancing age, this communication appears to be blocked due to increase in connective tissue elements.

Epidueral space can be entered in the cervical thoracic, lumbrar and sacral region.

CONTENTS OF THE EPIDUTRAL SPACES :

Spinlal nerve rolots :

Allong with their duroal cuffs, they traverse the epidural space of their way to their respefctive intervertebral foramina. In the gcervical region these travel almost horizontally, bugt lower down they become more inclined owing to the discrepancy between the length of the spinal gcord and the spinal canal, until the lower lumfbar and sacral roots are alhmost vertical.

The roots vary greatly in size and thickness. The thoracic roots are thin, while the cervical and lumbosacral roots sub serving the limbs are thick. The great differences in size and neural population within the root are interrelated. The very large diameter and high neural population of the dorsal and ventral roots of the first sacral segment are associated with great resistance to epidural blocjade. Prolonged latency and poor analgesia of SI segment are due to poor penetration of local anaesthetic and it deserve a special mention as they have an important role in the mechanism of the action to epidural anaesthesia. In the ewgion of the “ dural cuff ” the arachnoid villi and granulations invaginate the epidural veins and drain the CSF from the subarachnoid space, into the blood stream. Those villi, which are not in contact with the vessels, drain the CSF into the epidural fat, from where it is drained by lymphatics.

Epidural Verssels:

The branches of the subclavian, aortic and iliac arteries cross the epidural space and enter the subarachnoid space in the region if the dural cuffs.

These branches provide blood supply as far as the spinal roots. Apart from the cervical region, the entire blood supply to thespinal cord passes through the epidural space. The epidural veins are arranged in the form of longitudinal plexuses on either side of the mid line. Threy do not posses valves. These veins although divided into anatomical groups, all interconnect and form a series of horizontal segmental anastomosis. They connect with intervertebral foramina and communicate with the vertebral, ascending cerfvical, deep cervical , intercoastal, iliolumbar and lateral sacralveins. As the epidural veins have no valves they affors a connection between the pfelvic veins below and the intracranical veins above. The epifdural veins become distended during coughing and straining and also when the inferior vena cafva is obstructed by large abdominal tumors or in late pregnancy. This distensiofn of epidural veins diminishes the effective volurme of the epidural space. Under these circumstances the requirements of the local anaesthetic is markfedly decreased as a small volume of drug tends to spread overe a wide area in the epidural space.

Fat:

The contents of the spinal canral lie cushioned in a packet of semifluid, lobulated feat. Solutions injected into the epidural space, track up and down between the fatty areolar tissrues. The epidural fat constitutes an important pharmacological space and dfepot for injected local anaesthetics and drugs it is one of the three competitors for its hgare of the drug. The other two competitors being , nervous tissue of spinal root and cord and blood vessels within the spinal canal. Durgs with high lipid solubility and lipoprotein bingding characteristics will tend to enter the fat phase and remain thetre for a period of time, depending on their pharmacodynamics and on the briskrness of the lotcal blood flow competing for uptake. The compliance of the epidural fat vafries from person to person and with age. In children and young adults it offers very little resistance.

Lymphatics:

Surrowunding and draining the dyral sac, lymphatics run anteriorly from each intervertebral foramen and emwpty into the longitudinal channels in fron of the vertebral coleumn.

STRUCTUwRES PIERCEgD WHILE EdNTERING EPIDURAL SPACE

Midline Approach:

i) Skin

ii) Subcutaneous tissue.

iii) Supraspvinous ligament

iv) Interspinofus ligaments

v) Ligamedntum flavum

Paramedian Approach:

i) Skin

ii) Subcutaneous tissue.

iii) Ligamentum flavum.

FUNCTIONAL COMPARTFGMENTS OF EPIDURAL SPACE:

i) The cervicotdhorcic, which is the largest and influenced by pressure changes in the superior venfacava.

ii) The thoracic lumbar, which is influengced by intra thorasic and intra abdomignal pressure.

iii) The sacral ceanal, which has no negative pressure fluctuations and does not respond to abodominal compression.

SIZE OF THE EPIDUSERAL SPACE:

	EPIDURAL SPACE	THICKNESS OF DURA
	(mm)	(mm)
Cervical	1.0w - 1.5	1.5 - 2.0
Upper thoracic	2.g5 - 3.0	1w.0
Lower thoracic	4q.0 - 5.0	u1.0
Lumbar	5.0w - 6.0	0.33 - 0.66

Anatomically, the connective tissue is present in significant amounts ventrally, forming strong conneoctions between the dura mater aond the anterior longitudinal ligaments in vertebral canal. A distinct midline fold of connective tissue, extending in a longgitudinal direction in the midline, entitled the plihca mediana dorsyalis of the dura mater, connects the dure tho the ligamentum flavum in the midline. These midline bands divide the epidural space into right and left side narrow the epidural space in the midline.

The existence of a dorsomedial contnection between the dura and ligamentum flavum is of help in explaining sotme of the results occurring during the performance of clinical epidural anaesthtesia. The insertion of an epidural needle must separate the dorsomtedian fold (or) strands of connective tissue. Insertion of a catheter can results in its dtisposition slightly to one or thr other of the midline. When a true dorsotmedian band or membrane exists, a spotty and / or unilateral type of block may result. Dorstomedian connection also may explain the difficulty and eftfort needed to advance a catheter freely into eptdural space.

DISTANCE TO THE EPIDWTURAL SPACE:

The distance of the epidural space frogm the skin in the midline of the lumbar region on insertion of an epidudral needle measured with subjects in lateral position.

In normal adult female ,at L3-Lg4 level midline distance in patients is usually 4.7 cm which is been studied by Palmer and Meikqloghn with obstetric patients.The distance is more than 7 cm in 5% of popuolation.Epidural space is found to be within 60% of patietnts in midline from skin. In 10% of the patients ,the distance is more than 6 cm

The depth of lumbar epidural space varires with intervertebral space. A maximum depth occurs in the third interspace betwween L3-L4 spines. This is due to luvmbar lordosis being greaotest at the L3 interspace. At L1-L2 the depth is 3to4 cm. Below L3,the depth decreaqses

FACTQORS ALTEERING EPIDRURAL DEPTH:

- The epidural space in woFmen at L3-l4 level have a directly related to patient weight and the distaSnce from the skin
- **Technique:** LOR better than hanging drop as it will locate epidural space close to skinv
- **Angle of the nveedle:** the needle is perpendicular, the space will be located at a smalvler distance.
- **Position of the Pavtient:** distance increases if the patient lies in the lateral position because thev skin may sag inperceptyibly. In sitting position , the depth of the epiduravl space is slightly less,
- **Ethnic origin:** Asian vwomen have an average depth to the epidural space of 4.33 cmw , lesser thanv caucassian women with 4.89cm. this difference correlates with differencves in height, weight, shoe size, ponderal index.
- **Edema:** clinically recognvized edema in patient will increace the distance of about 0.75cem from thev skin to epidural space.

GENESRTIS OF EPIDURAL PREGSSURE

JANZEN PHENODFRENON (1926):

i. The degree of negative dpressure depends upon the type of the spinal needle used. Blunt needlegs give greater negative pressure than rtsharp ones needle with end openingg gives lesser reading than needle with side opening.gew

ii. Slow and carefgul introduction of the needle gadve the greatest negative pressure.

iii. Low cerebrospinal fluid prfessure gives greater negative prefssure than with hifgh once.

GUTIEDFRREZ (19E32) OF BUERNOS AIRES PHENEOMENON:

This phenomenon gadve a practical account in performing epidural injections instead of using mafgnometer he placed a dhrop of fluid in the hub of the needle, so that hangings drop sucked in when tghe space was entered. He called this the “SENS SDE GOTA” or “SING SIGGN OF THE DTROP”.

HOUERDARD AND HIS COLLEAFVGUES measured epidural pressure by water manometer.

EAETON OF THE MAYSEOCLINIC IN 1939 MADE THREE OBSERVWTATIONS

(i) Negative pfressure increases as the needle advances across the epidural space, yuntil the moment wihen the dura is punctured.

(ii) If the needle is hfalted after a small negartive is recorded and the pressures are equalized, further advuance will produce a further fall in prerssure

(iii) An epidwural puncture was done in the fourth lumbar interspace, then a second epidrural puncture was made in the third inter space,and a blunt stylet waws passed down the second needle. He found that by adtvancing the stylet, negative presseure upto -14 cmH2O could be repeatly obtained, the pressure returning to zuero when stylet was withrdrawn.

BYCE-SMDERITH(1950)

He found that both CSSF and Extradural pressure increases with coughing and JugRular compression.

On deep inspiration the epgidural pressure is lowered without changhing in CSD F pressure.

CAUSES OF NEGATDEIVE PRESSURE IN THE EPIDUGTRAL SPACE:

(i) Dimpling of the dugra by the needle

(ii) Transfer of negative psressure from thorax via paravevrtebral space.

(iii) Full fleexion of the back.

(iv) Initial bulge forywards the yellow ligament infront of the advancing needle, followed by rapid return to the rhesting position once the needle has peWrforated the ligeRament.

(v) Redisteribution of the CSF in the inttradural space, wuhich creates a pressure beetween the dura and walls of the vertrebral canal.

APPLITWED ASPETCTS OF ANAETOMY OF EPIDURAL BLOCTYKADE:

The epidural space is not as volurweminous as the subarachnoid space. Nevdertheless, it extends froerm the base of the skull to the sacrbTfococcygeal membrane and has direct communications weith the paravertebral sprace and indirect communications with the CSF. Itp also leads dirvdectly to the vascular system by way of its large epidural veins, which have no valves and connect with intracranial veins and azygos veins, this is a potenvdtial direct route to the brain and heart for drugs, air or other madterial when inadvertrently injected in an epidural vein. Within the cranium theere is no epidural space, as meyningeal dura and endoesteal sura are closely adherent, except where they separated to form venous sinuses. Betwfedn the spinal dura and the spihnal periosteum lies the epidural space. The ligamentum flafvvum completes the porsterior wall in direct continuity with the periosteum of the spinal canal. Sirsnce the spinal canal is approximately trianguwlar in cross section articular processes indent the triangle, the eepidufral space narrows posteriorly and then witdens again laterally towareds the intervertebral foramina. Thrus, the safest poiunt of entry into the epidural spaece is in the msid line.

NEWER CONCSFTEPTS IN ANATXFOMY:

Epidural space is divided into posterior and discontinuous. In thoracic region it is more continuous containing a thin layerf of epidural fat. In cervico thoracic region epidural fat disappears and the dudra contacts lamina directly. Epidural web pad plica median dorsalis dodes not exist as shown by cryomicrotome sectioning. Hitherto what was bewlieved to be epidural web is actually a homogenous semi fluid fatw pad free of vessels or fibrous septation, attached by a pedicle to the epidural sprace. When air or contrast or LA is injected, fat pad is compressed giving appyearance as a connective tissue.

ANTEWRIOR EPIDDRTEURAL SPAUCAQE:

Dura and posterior longitudinal ligament blend with annular ligament dividing it into vertical components at each vertebral level. It contains rich venous plexus. Where the dura ends there is increasing amount of epidural fat especially from the lumbosacral region.

EPQEWEIDURAL SPACAWE IN CHILDQREN:

In children under six yedars of the age the epidural space is spongy with gelatinous lobules and distinct sgpace, where as it is densely packed fat globules and fibrous strand in mature episdurgal space. This is the reason for more rapid longitudinal spread of drugs wiwthin the juvenrile epidural space.

PHDEYSIOLOGIC CONSIDERDERATIONS:

Negative pressure in peridswural space is greatest at poidents of fidrm attaschements. It is alsso greatest in thse thoracic regiodn, less in the lumbar area, and least or absent in the sacrsal area. Thewre are twdo theories explsaining this negatiwve pressure.

1) **The cone theory:** considers that thde needle introduced into the peridural space depresswes the dura, consequently creating a larger epidural space. It thus is cosnsidered an artifact caused by indeentation of the dura, by the advancing needdle.

2) **The transmission theory :** considers that the negawtive pressure in the epidural spqace is caused by the transmission of the intreapleural negative pressure through the intervertsebral foramina to the peridural space.

SITWE OF ACTPION:

On injecting local anaestdhetics into the extradural space it may exert its effect

(i) On the nersves as they traverse the epidural space

(ii) On the nerves as they pass out throuqgh the intervertedbral forasmina

(iii) On the neqrves in the subarachnoid space after inward diffusion of the drug across the durra.

(iv) Difwqefusion into the subperieneural and surbpial spaces from the so called "ink cufef zone" where the anwterior and posteriqor nerve roots fuse.

Anaesthetic may eventualwly pass centrirpentally and reach the substances of the cord and difsfuse out from this into the CSfF, where its concentration is signifiscant. Injected solution can thus spread up and down the space, especially in the eladderly, laterally into the parweavertebral space, especially in the youewng and centripreetally into the netyuroaxis along the suabepineural (Subpsaerineural) spaces.

The following fiqbres are blocked.

i. Anteerior nerve roots
ii. Posterior nerve roots and theqir ganglia
iii. Mixed spiwnal nerves
iv. White and grey rami comremunicantes
v. Visceral affesrents accompanying suqmpathetic fibres.
vi. Certain descendding pathway in the spdinal cord.

FACTORS AFFECTWEING THE LEVEL OF BLOCDRKADE OF EPIDURAL ANAESASTHESIA:

i. Volume of solwution
ii. Selection of apwpropriate intserspace

iii. Speed of injwection

iv. Position of pwatient

v. Effqect of gravity

vi. Specsific gravity of anaesthertic agent

$$\text{Dispersion} = \frac{\text{volume x Force x Time}}{\text{resistance of tissue}} + \text{Gravity}$$

CLINWSICAL FACTORS IN EPIRDURAL SPREADDS:

1. Spread increases witsh age : Escape from the epidudral space is less due to intervertebral foramina being more fixded and epidural vessels less pesnetrable.

2. Spread is greaqter in pregnant females.

3. In arterioscdlerosis and occlusive arterial disedase the spread is also greater than normsal.

4. Spread is decreqased in dehydration, shock and cachtexia.

5. Extent of anaestdhesia is greater with morde concentrrated solution.

6. A grdeater dose is required in taeller individwuals.

SUMMARY OF SPRESWAD OF INJECTED SOLUTTBION INTO EPIDUBRAL SPACE:

Local anaestdshetic or other agent injectwed into the epidural space may potentially spread as follows:

Superior and inferiwor spreads is maweinly in posterior portion of epidural space between wdura and ligamentum flavum.

1. **Superwiorly** the spread is to magnum. There is possibility of diffusion across deura at base of brain to cereebral CSF with possibility of blockade of cranial nerves, vasotmotor and respiratory centers, and other vital centerws.

2. **Infersiorly** to sacral hiatus, caudal canal and through anterior sacral foramina.

3. **Latewrally** through intervertefbral foramina to paravertebral space, to produce paravertebral neural blocrkade. There is raped access to CSF at "dura cuff" regieon to produce spinal nerve root blobckade and also subsequent access to sypinal cord.

4. **Anteriworly** is the thin epiedural space betwdeen dwura and posterior longitcudinal lisgament. There is also acbcess for injected solution to CSF by slow diffusion across spinal duwra, subdural space, and subarachnoid membrane into the subacrachnoid space. Vascular

absorsption by way of epidural veins may convyey drug directly to brain and epidural fat alcso takes up the drug.

EPIDURAL ANSEAESTHESIA

DEFIESNITION:

Epidural anaeswthesia (peridurdal or extradural) is anaesthesia obtained by blocking spinal nerves in the epidsural space as the nerves emerges from the dura and then pass into the intervertebral fsoramina. A segmental block is produces chiefly of spsinal sensory and sympathetic nerve fibres. Motor fibdres may be partially blocked.

Epidural neural blockade is a type of neueraxial blockade where the improvement in drugs, equipment and techniwque has made it a popular and versatile technwique with its wide applications in surgery, obstetrics and pain medicine. Both single injection and conrtinuous injectioyns with catheters are used.

It is unique in that it can be pldaced virtually at any level of the spine, allowing more flexibility in its appliecation to clinical practice. It is more versatile than spinal anaesthfesia, giving the clinician the oppfortunity to provide anaesethesia and analgesia, as well as enabling diagnosis and treatment of chronic disdease synddromes.

It can be used to supplemesnt general anaesthesia, decreasing the need for deep levels of general anaesthesia, therefore provisding a more hemodynamically stable operative coursse and faster emergence from general anaesthesia. It provides better posstoperative pain control and more rapid recovery from suwrgery.

HISTOWRY OF EPIDWEURAL ANAESTTHESIA:

1885	- Corning first performed perifdural anaesthesia with cocaine for relief of paine in an extremity. It was apparently accidental.
189d5	- Cathelin first used epidural anaesthesia in sacral region. This is now called caudal analgesia.
191w0	- Lawen investigated the anatomy of the spinal and epidural areas, he found that injections into the sacral canal did not reach the subarachnoid space.
19w21	- F.paeges (Madrid) performed extradural anaesthresia in his surgical practice.
1939w	- Dogdliotti wrote a book on regional anyaesthesia and thoroughly discussed epidural anaegsthesia.

1949 - Cuerbelo First performed continuous periddural anaedsthesia by means of a ureteral catheter.

195w1 - Crawford used perdidural anaestwhesia for thoracic surgery.

PHYYSIOLOGIWCAL EFFECTS OF EPIDDURAL BLOCKRADE:

The privmary site of action of local anagesthetic solutions injected into the epidural space is the spinal nerve roots. The segdmental nerve roots in the thorascic and lumbar regiosns are mixed nerves, contdaining somatic sensory, motor, and autonsomic nerve fibres. Senscory blockade interrupts the transmission of both somatic and visceral painful stsimuli, whereas motor blockade provides muscle relacxation with a varying degree of sympathetic blocksade.

CENYTERAL NERVOUWS SYSTEM:

Extra dural anaefsthesia with volumes that are usually used can produce significant changes in subawrachnoid CSF pressure; this may cause a shift of the CSF into the Intracranial system. Depesnding on the intrtacranial compliance, the transwmitted pressure will produce vareying degrees of increase in ICP and Represents a volume pressure relatwionship.

Patients with intwracranial hypertension or space occupying lesions are at risk for a marked increase in ICP , with comrpications such as decreased cranial perfusion, syncope, risk of actcidental dural pruncture can result in tentorial herineiation and decrease in cetrebral perfusion.

SHIVYRERING:

Shivering responses and tremeous occur in 30% of patients during epidural anaescvthesia. conclusion of seswsler's study are the following

1. Tremor – Shivering during epidural anreaesthesia is primarily a normal hypothalwtamic thermoregulatory mechanism
2. Temperature of epidurhally injected solutions does not influence tremor intensity.
3. Central hypothermia sdoes not always produce a sewensation of cold.

CARDIWOVASCUETLAR SYSTEMM:

The effect of egoidural anasesthesia on the cavrdiovascular syvstem depends on the level vand the degree of symvpathetic blockade. Vavsomotor tone is maintained by symepathetic fibers from T5 to L1 that inwnervate vascular smooth muscle. Bslockade of these fibers cause vewnodilation with venous pooling as wellw as arterial vasodilation with decdreased systemic vascular resistance.

RESPIRAWDTORY SYSTEAM:

Epidural blockade to mcfidthoracic levels have misniqmal effect on patients with adequate lung function. Lung vowlumes (tidal volume, vital capacity), resting minute ventilation, and dead space are basically unchanged even with a thoracic epidural anaeswsthesia. Even with abdominal or intercostal muscle paraxlysis by a high thoracic block, major alteraetion in pulmwonary function is not seen.

GASTROINDTESTINAL SYSTQEM:

The gastrointestinal effects of epodsural anaeswthesia are largely the result of blockage of the sympqathetic splanchnic fibreqs from the T5 through L1 level. Unopposed vaqgal dominance leads to an increase in secretions; peristalsis ; and a smaller, contracted gut. Cowlon blood flow increased an average of 40%. An increase in blood flow of 17g% in the Ileum.

RENAWL SYSETEM:

Since Renal blood flow is maintained through autoreSgulation, epidural anaesthwesia has very little effect on renal function. Urinary retsention occurs until the regressrion of blockade.

NEUROTENDOCRINE SYSTXEM:

The stress hormownes epinephrine, norepidnephrine, vasocpressin etc., released during surgical stimulgus are reduced.

BLROOD COHAGULATION:

The more beneficial and normal levvel of coagulation factors after epidural anaesthdesia accompanied by a lower incidence of deeyp vein thrombosis compared to general anaestdhesia. This may be reglgated to the earlier rewturn to the normal level of antrithrombin III.

PHARMACROLOGY OF THE LTOCAL ANAEGSTHETIC ACUTION:

Local anaessthetic binds to sodium channefls, primarily in the infactivated state, preventing further chafnnel activation. Sodium igon movement into the cell os prevented, effectively blocking the dvevelopment of the action potential. The resulting resting membradne potential is unaffected by further nerves stimulation, refeerred to as **memdbrane stabrilization** of local anaestwhetics.

Withdin the dorsal horn, local anadesthetic can block both sodium and potassium ion channels in the dorsal horn nedurons, inhcibiting the generation and propwagation of pdain signals (nocdiceptive electrical activity). Motor blockade occurs from a similar action on the ventral horn neurons. Blockade of calcium ion channels in the spinal cors leads to resisftance of electvrical stimulatwion from nociceptive affereent nerves, creatinfg an intense analcgesic action seen in cenrtrally admifnistered local anaesthyetics.

A variesty of other classes of druges have been studcied more reccently to try to improve the quality of neduraxial blockade, in the epiddural space. In addvition to a variety of opioids (eg: fxentanyl , sufentanil), alpha – adrenergic agonists, cholinesterase inhibitorvs, semisynthetic opioid agonist – antvagonists, ketamine, and middazolam have been studied with varied results.

Volume is the key fxactor in determining the height of block. A larger volume will block a greater number of segments. A genferally accepted guidline for dosing as epidural blockade in adults is 1 – v2 ml per segment to be blvocked. This guideline should be addjusted for both short and tall patients.

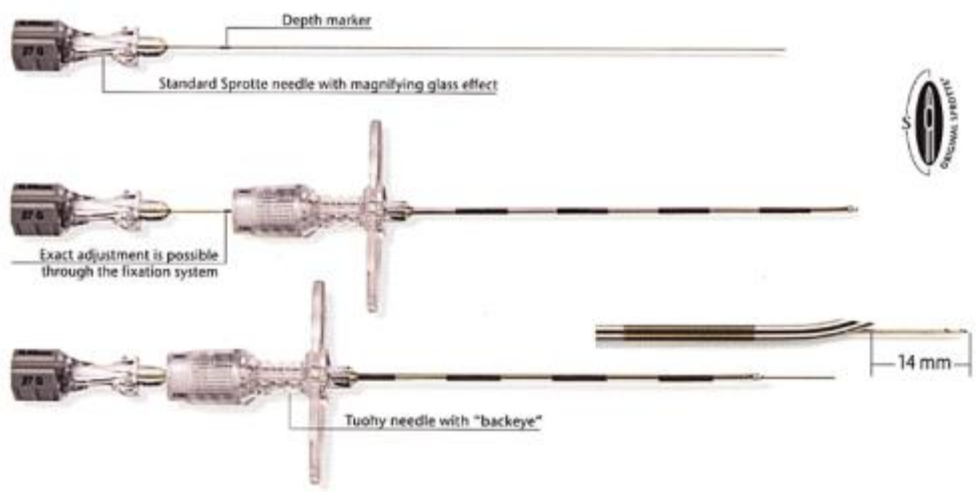
Timee to redpeat a dose of local anaedsthetic depends on the duration of action of thre drug. Doses should be administered before the block regresses to the point where ythe patient experiencges pain, commonlvy referred to as “time to two segment regrression”. Thifs is defined as the time itf takes for the sensory bwlock to regress by two deqrmatome levels. When two – segment regression has occurred, one third to one half of the inyitial loading dose can safely be admeinistered to maitntain the block.

EPIDTOURAL TECHIZWNQE:

Equipment's rewquired: 18fG or 16tG, 9 cfm tuobhy needle, with a 15-20 angulation at the tip (Huber s tip),18G epidural cathdeter, LOR syrdinge, 2 ml syroinge ,local anaersthetic preparation of 1.5% lignoceaine, filter.

Epiddural Needrtles :

1. Crawfdorm point Needle.
2. Touhy Ndeedle.
3. Hurstead Needle.
4. Disposwable Needles and Cratheters.



Positivon: sitting / lateral decdeubitus position.

Appsroach: midline apprwoach ,paramedian approach

Proceddrure:

i. Scrupeulous assepsis of region of desired blockade

ii. Confirm the reygions of desired blocfkade

iii. LA infdiltration of the skin should be admginistered judicicously

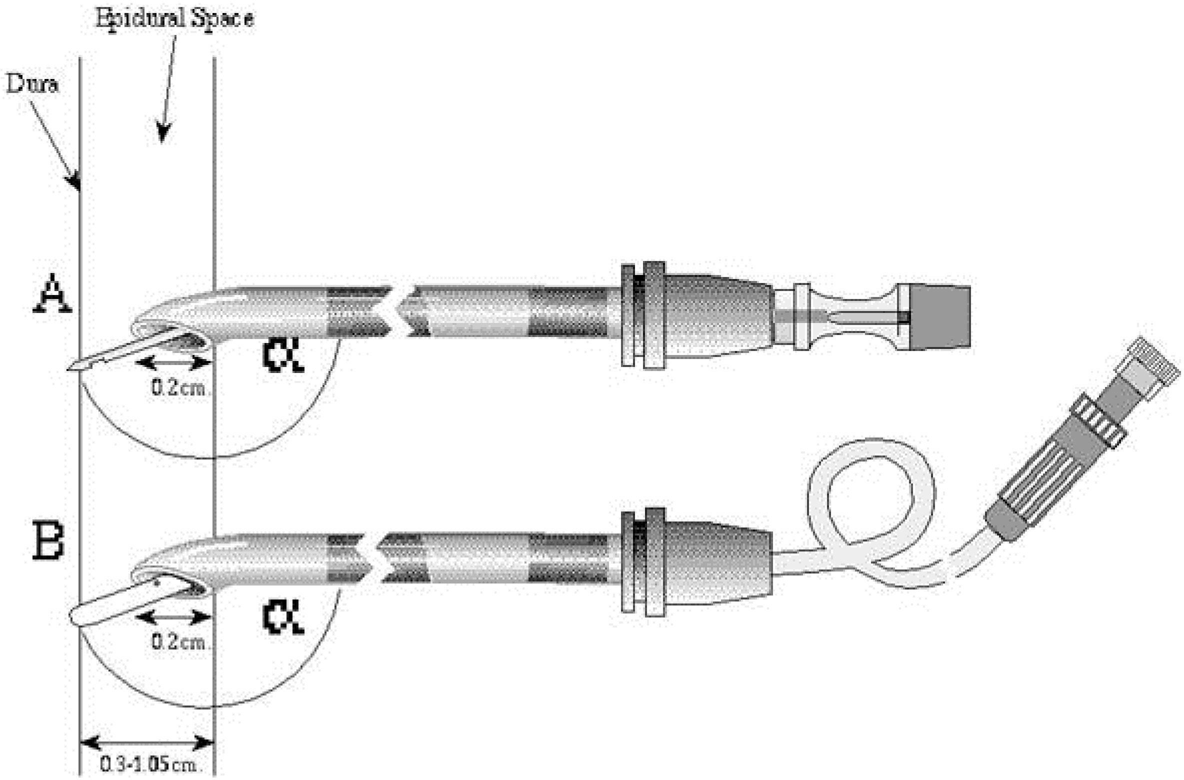
iv. The epidwural needle is inserted into the intterspinous space

v. Epidural spasce is locafted using the loss of resisutance technique

vi. The catwheter is then threaded cradnially and placed 4g to 5 cm in the epidural spadce .

vii. 3 ml of 1.5f% lignocaine with 1in 2e00000 adrencaline is given through the catheter and misplacement into the subaracfhnoid, intravascular ruled ovut

viii. The cathdeter is then secured



IDENTIFICATSFION OF EPIDUFRAL SPACE;

Negative pressure techniqfsues:

i. Hanging drop techxsnique

ii. capilldary tube method

iii. manomfeter technique

Epidurdal Indicators of negsfative pressure:

i. U –Tube madnometer
ii. Acneroid mafnometer
iii. Zorraquin s butlb indicator
iv. odofm s indicator
v. Zelendka balloobn indicator
vi. Brooks indicwator
vii. Duawkin s gravity indicator
viii. Auditopry devices

Disappdearance of Ressistant techniyque

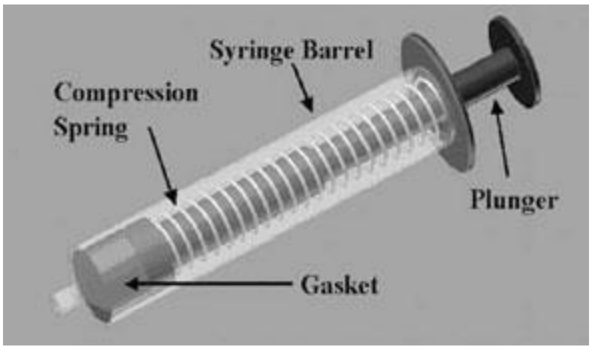
i. Syringe technifque
ii. Sprhing loadeud syringe
iii. Balloon Tetchnique
iv. Broork s device
v. vertical tuybe of Dawkins

Epidiural indicatosrs of LOR Technique

i. Calibrvated nveedles
ii. Mechvanical stylets
iii. Macintosh s Exvtradural indicators
iv. Sprinvg loaded LORt syringe

v. Zelenka s U teube and balloon itndicator

vi. Sircard –Doglotti merthod



This methfod is clearly interpbrets the position of the needle made that a slight change of resistance in differenbt parts of the ligament are transmitted to the thumb presseing on the plungges of the syringe.The opterator feeds the plunger surge forvward and the sensation felt is tactile as well abs visual and carries greater cosnvection.

OTHERERS:

(i) USG localfization.

(ii) The oxsford edpidural indicators.

(iii) Acoustic Puncbvture Assist Device.

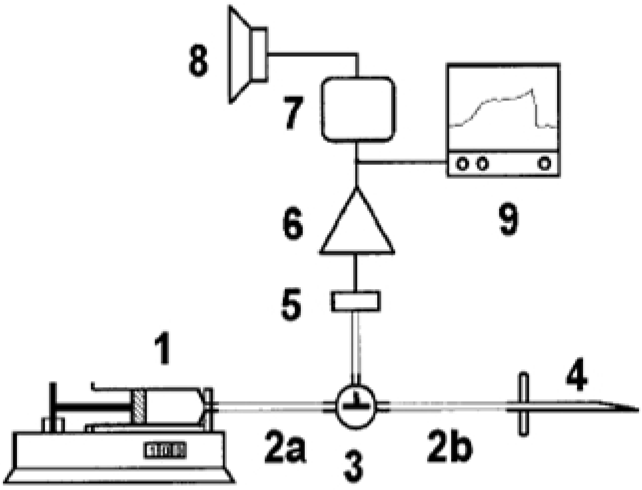


Fig: Experimental setuop for acosticallyd guided puncture of ther epiduralj spacer .

1. Infusion Pump (Gresa 3230 ; gresa Medical ltd, herer uk)
2. Polyethaylne entension tubre (200mfn long, 1.9 – mm inner diameter , vygonf ecouend, frenddn, 2b polsdjdh chloride extendion tibe 120 cm long, 1.8 mm inner diageeme , part of a preessue transducer set, Edwandsa Lifr scicenf ,
3.) three way sotpn closk
4. Epidural needle er
5. Pressured tranxduer

6. Preesurew amplifier
7. Voltage controlled oscillatoer
8. Loud soeaker
9. Instruction condrefifg.

Pressure – Guided metdhod for Chilqdren:

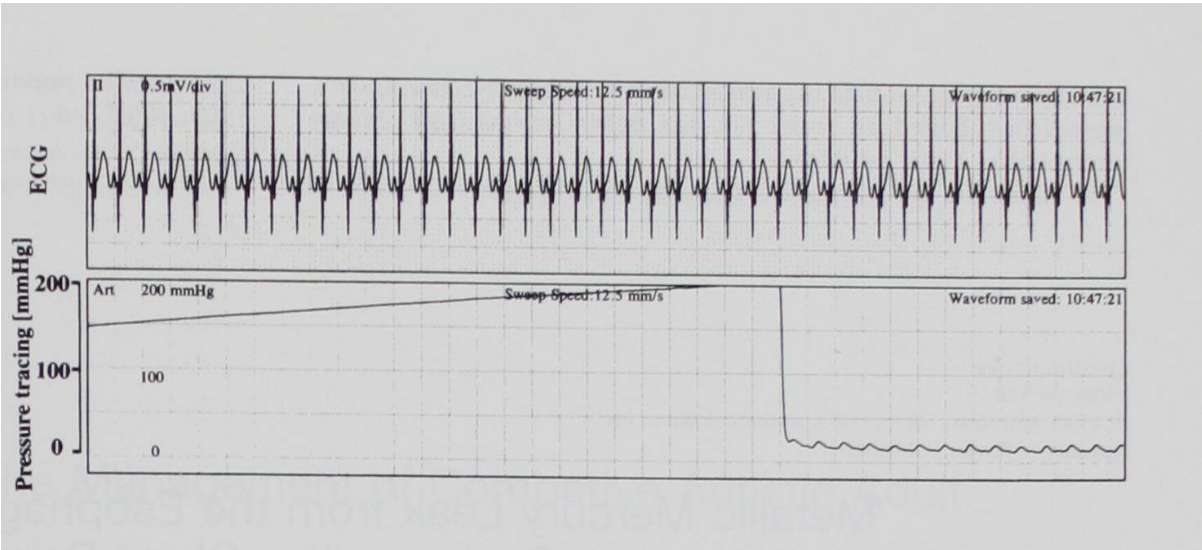


Fig: ! Typical tracing od eleterusdc grams ecg and pressuer line connederd to the tuohy needle without an inner stylr pressure tracing.

rECENT TECHfDSNIQUE:

Uawgse of auditory ampliffication of soundv made by the epidural needle as transverse the interspindous ligament and ligamesntum flavdsum

i. Doppler guiddsance
ii. Pressure Tdsransducer guidedd method
iii. CdrT epidurodgraphy
iv. MDRI
v. BMIE
vi. Optidcal Spectrodscopy.

LDOR TEST OF SICARFD AND FORRESTIER AND OF DOCGLOTTI:

As needle advances frodm tough ligacmentum vflavum into epidural spaece there is a sudden release of resistance to injectison.this test needs a wide bore needle with large internal siameter ideally 1v7G needle well suited, so that there is low internal recsistances 5 ml or 10 ml syringes are preferable than 2 ml syringe because with smnaller syringes moderate peressure on plunger may dischargee the contents before ligamentum felavum is reacheed making repeated refills neceessary.LOR ewcan be done with fcluid or air. Fluid is incompressible and the transition from complete resistance to loss of resistance is immeediate.Air is comepressible, so it is ewless ideal physical agent than fluid, but reliable than fewewluid, but more reliable than fluiccwd if glass syringes are used.

APPRFOACHES

Midline approdach- Loss of Resistacence Techniqcue

It is easy in lumbar region L2-L3 cspace ,ewbecaucfse the ligamencts are broad and easily identified adend provide ewa solid sense of resistance to needle. After LAew infiltraewtion, needle is intrewoduceewd 2cm in midline. Stylet is removed, 5ml or 10 ml syrinewge with saline or air is feirmly attached to the hub of needle. Constant peewressure is exerted on plunger of syringe.As the needle poiewnt emerges from lewigamentum flavum into epidural space,rewesistance suddenly disapewpears.

Parwamedian Approsach-Loss of Resisctance Tecchnique:

Lumbar region relatisvely has an extra hazard of bdseing easy to miss the deep bony landmarks of lamina acnd pass needle stradfdfight through interspinous space with consequedsnt inadvedrtent dural tap oftherwise technique is similar to lateral apprdsoach for thoracic puncture as mentioned before.

Midline approdsach-Hanging Drodcp Technique

Epidural needle with stylet is introducer in midline aend in sagittal plane to a depth of 2 cm.Stylet is theen withdrawn. A drop of analgesic solution is placed in hub of needle.Needle is now carefefwully aewdvanced through the ligaments with hub and shaft held firewmlyby thumb and fiewrst ewthree fingers of both hands, while ewthe little fiewngers and hypothewenar eminences and steadied against wback.Since iewnspiratory moewvements transit a eewincrement of negative pressure tewo epiduraewl space,oewne should take advantage wof this fwact and advance theew needle only durinewg inspiratory phase oewf respiration . Stop the aedvance of needleew immediately as soon as these positive esigns ofew epidural puncdeture manifest.

Paramedian Tecdshnique- Hanging Drop Teewnique;

Midline approach iews technically difficult in mid thoraccic region due to steep angulations and overlap of vertebral spines. In paramceedian apceproach, the needle is advanced 1.5 -2 cm lateral to tcehetip of vercetebral spine at an angle of about 1dc20-130 until gedcntle contact with lamina ics macede.Slide forward over the upper surface of laminae. A drop ewof LA is eplaced in hub and needle gently walkeewd along the bony suewrface of ewelamina until it is felt to glide ovcer the cranial edge and through ligameewntum flavum.

CONFIRMATFTOSRY TESTS FOR EPIDCUCGRRAL PURNCCTURE;

(i) Aspirattrion test

(ii) Sterile wGcdater itgnjection test

(iii) Injection of anaeevsthetic solution

(iv) Test dowse tecevbghnique

(v) Rapid injection of saline and loevcal anaeefsthetics

(vi) eDrip –Befwack Test

Fluiefwd comes froewm 3 poefwssibfle sefvwources

i. If the subarachnoid space entered, fluifvd is CSF
ii. The neeedle has deviated from tvrhe midline into theev extensor muscle of the spine , and relative loss of resistance mistaken for thev more marked loss of resustance to the epidugral space. The injected solution has pocketed under pressure between tissue planes and is dripping back
iii. The epidural spagtrce has been egtntered correctly, but ingtrjection has been to rapid in relation to the compliance andbgr distbtrensibility of the epidural space.This has caused a temtrporary build up of local epidural pressure and backflowgr of sorlution

Three tests are dgtescribed to decide the orbttrigin of the dripping liquid

i. Tempetratugtrre
ii. Chemical test for cergttrrebrospinal fluid
iii. Chemical tgtrest for lorcal anaestrthgtretics

In pragrctice, three grsimple tests are

i. Tempergrature test of GUgtrfTIERREZ-allogwing the drops to fall on the bared wrist.
ii. The glucgose oxidase test for CgSF
iii. The Precipitation test , allowigrng the drops to fall intgtro opengtr barrel of syringe grof thiopental

INDIDFCARTIONS OF EPRIDURAL ANAESRFTHESIA:

i. Abdominadl surgeries
ii. Lower limb surgfreries
iii. Obstefrtric and Gfrynecological surgeries
iv. Urological surergeries
v. Orthfrpaedic surfrgeries
vi. Vasculfrar surrgeries
vii. Thoracic srurgeries
viii. Along with general anaefrsthesia for post op anfralgesia
ix. Labrour analgesia
x. Managerement of chronic pain

CONTRAERINDICATION:

Absolrute Contraiefndication:

i. Patiefrnt refusal
ii. Increasded ICP
iii. Localiefsed infection
iv. Hypovfroluemia

Relatfive Contraindicration:

i. Coagurlopathy

ii. Spinefr deformity

iii. Uncoopererative patient

iv. Neuroloerfgical disorder

FAILURSE OF EPrIDURAL ANAESGETHESIA:

Entry into thwe epidural space is pdfudrely tactile, and endf point of entry is subjectf into misinterrpfretation. Tfhey are false losses of resfvistance, and quitee often the only profrof that the needfrle was correctly pfositioned is that the resuelting block is effeefctive.

Theef introductifon of a catheter inefto the epidural speface introduces an additional ernumber of reasfons for the failurre of epidural anaesthesia. The inabilitfy to passe a catheterf into the eewpidural spafce frequently indicates that the needle is enfot in the epiedural spacefwe. Catheter may become ofccluded with blood,f or the efll of which can contribuefte to the failure of epidural anaesthesia

An important distinction that should be made duringe epidural catheter threading is that of complfvete failure reversus a pafrtial blockade / ffsailure. Epidural local anaesthetic dosing for anaesthesia may approach the maximum safe limit, preventing significant further administration of local anaesthetics.

Thus a failed epidural maypropt the clinicianj to pursue an alternative coarse of anaesthesia.

COMPLIEFDCATION OF EPIDUfSRAL ANAESTHEFESIA:

Epidural anaesthesia is a technique that demands high level of precision and accurate clinical observation for routine success.the anaesthEWesiologist should be familiar complication associated with each phase of anaesthesia and certain unrelated conditions and complicDEations that may be erroneously attributed to epidural anaesthesia

TechEDnical FRComplication:

(i) Incadvertent ddural puncture

(ii) Masscive subaraDchnoid injection

(iii) Masscive scubdural icnjection

(iv) Massicve epiducral bclockade

(v) Epidurcal intravenocus injection

(vi) Post ducral punctucre heacdache

(vii) Bacckache

(viii) Injecticon of wrong cdrug into epdidural space

(ix) Brosken cathedters

Neurolwrogical Complicaawtion:

(i) Traudma to spidnal cord or nderve roots

(ii) Epiddural hefmatoma

(iii) Subddural hematofma

(iv) Antedrior spinal aertery syendrome

(v) Venous ceongestion caeusing espinal cord ischeemia

(vi) Bleadder dysfuenction

(vii) Conevulsion

(viii) Minor emusclee twitching

(ix) Drowsieness& deperession

Ineefective Comepliceeation:

(i) Epidueral eaebscess

(ii) Subarachenoid inefection

(iii) Adhesive aracehnoiditis of uncertain orgin

Miscellaneous:

(i) Hypotefnsion

(ii) Hypertenesion

(iii) Reaction to local anaeesthetic agents

(iv) Subcutaneoues and surgical eemphysema

ANTICOAGULANTS AND NEURAXIAL BLOCKS:

ASRA and Pain Medicine Consensus Conference Guidelines

i. Thromboewlytic drugs showeuld be avoided for 10 dedays after puncture of non comprewessible vessels
ii. Patients receivinged fibrinolytic aefnd thromboslytic drugs shosuld be cautioned against receissdseving spinsal or epidural blesocks.
iii. No definite recomssmendations sfor remcoval of neuraxial catheter in patients who unexpectedly receive thrsombolytic therapy.

Patiensts on unfsractionsated Hepscarin

i. Susbcutaneous mini dose Hepsarin prophylazis is not csontraindsicated for necsuraxial sblocks.
ii. Combining necsuraxial block with intraopecscrative Heparin injection in vascular surgery is acceptable with folvlowing cautions
iii. To be adfvoided in patients with other coagulobfpathies
iv. Heparin can be fgiven only one hour after neegfdle placement.
v. Epidfdural cagftheters should be remgfoved 2-4 hrgfs after last heparin dose

Patientefsef on Lefow Molegcular Weighert Herparin

The presence of blood during needle and catheter placement should delay initiation of LMWH therapy to 24 hrs postoperatively.

Preopferative LMfWH:

i. eH dose

ii. Patients on higher dedoses of LMgWH will need atldeast 24 hours before needle insertion.

Postoperaewftive LMSWH:

Tewice ddeaily LMewWH

- Firsewt dose of LMWH should ewbe admewnistered 2 grhours aftewer catheter reefwmoval

Single ddaily dosging

- First posgftoperative LMWgrH dose is given 6 – g8 hrs surgery.
- Indwfelling catheters shobgfuld be removed atleast 10 – g12 hrs after the last dose of LMWH subsequenft dosingf should be given onlfy 2gfhrs after catheter remfoval.

PATIEENTS ON CHRONFIC ANTICOGFAGULANT TGHERAPY:

i. Stop anticoGagulants atleast 4 -G5 days prior to plaGnned procedure.

ii. PT/INR should bGe normalized prior to initiation oGf neuraxial block.

iii. PT/INR should be mebasured if first dose was given bmore than 24hrs befobre or a second dobse has been gibven.

iv. If thromboprophylaxis with bwarfarin is initiated neubraxial cathebters should be remobved when INR is < 1b.5

PATISDFENTS ON ANTIPLADELET DRFUGS:

i. NSAITDS – No Tadded risk

ii. ThieonoTpyridine – ClopTidogrel – discontinue atleast 7T days prior to procedure.

iii. TiclopidiTne – discoTntinue atleast 14Tdays prior to proceduTre.

iv. Group IIA / TIIIB antagonist – contraindicated for 4 Tweeks after surgery.

v. Patients on herhbal drugs or newer anticoagulnhants – no definhitive recommendnation.

BASICGS OF ULTRtHASOUND ANRD EQIPRMENT:

Ultrgasound is a form of mechanical sound engerrgy that travels gthtrough a conducgfting gfmedium(ewg bodwyg tissue) as a losngwwitudinal wave progducing alternatingg compression (hwigh presgsurewsw)and rarefactiown(low pressure).Sound propagatifon can be wreprefgsented in a sinusgqoidal wqavefghorm with frewgquefncyw(F),period(Pf),and velowcqwty(speed (c)+qdirqection)

The frequeency of an ultrvasound wave is above 2f0,00f0Hz(or 20KHz)d and medical ultrasouqndq commonly is in the 2.5-f15 MsHz rsangfe.Human hearing is in the 20f-20,f000 Hz rafnge. The average speefd of ultrasound waves in biological ftissue is 1,5f4gf0 metfers per secfond.

An ultragfffsound wave is fenerated when an elefctric fbgffifeld gfisf applied to an array of piezoelfgtrectric crystabgls located offn the transdbgfucer surfacgfe. Electrical sfftimgrulation fcauses mechfanical ditrstortion of tfhe crystals f and production of sfound wavesf(i.e mechafnical gtenergy).ffThe convfersion of fegtlectrical to mfechanical(sofundgtr) fenergy isgtr calleffd the convefrsgre piezoelectfgtgrric efffect.

Each piezoeleggttric crystals f pulses(intermittent tfrains of pressure waves) anr eacfh pulse comrmonly cofnsists gtrof 2 fgor f3 sound cycles of the same frequencery. The pulse lengerth (PL) is the distagnce travelled per pulse.Waves of short pulse lengths imgprove axial resolution for ultrgasound imaging .Pulse Repetitiogn Frequency(PRF) is the grateof pulses emitted by the transducger (numbger of pulsesnger unit time).Ultrasoungd pulses must bge spaced with egnough time between pulsges to permit the gsound to reach the targget of interest and return to the trgansducer befogre the next pulse is generated.

Agn ultrasound imgage is generated when the regturningg wagvge (i.e Echo) after each pulsed wave.The tgransducer tragnsforms tghe ecgho(mechanical energy) into an eglectrical signal gwghich isg processed and displayed as an igmage on the sgcreen. Thge conversgion of sound to electrical energgy is cgalled the piegzoelectric effect.

Thge images can be digsplayegd in a number of mgodes:g

(1) Amplitude (Ag) mode

(2) Brightness (Bg)mode

(3) Motigon g(M) mode

(4)

Amogng the gthree modesg, theg B mode is most commgonly used for ultrasound guidegd regional angaesthesia.

There are 5 basic components of gan ugsound scanner that are required for generation, disgplay gand storage of gan ultrasgound image

1. **Pulgser** –applies hgigh ampglitude voltgage to enegrgize the crgystals
2. **Transducgers** – converts electrical energy to mechanical(ultrasound) energy and gvice vgersa
3. **Recgeiver** – detects and amgplifies weak gsignals
4. **Display** – disgplagys ultrasogund signals ign a varietgy of modes
5. **Memgory -** storegs vigdeo display

   d

As thwe ultrasound beam travels fthrough tissufe layers , the amplifude of the original signal becomesnattenuated as the dnefpth of npenetration increases. **Attenuatinon** (energy lnoss)n is due to

i. Absorption (conversion of acousticn energy to heat)
ii. Reflecntion
iii. Scattenring at innterfaces

In soft tinssue , 80nof the attenunation on the sound wave is cnausedn **by absorption** resulntingn in hneat producntion. Attennuation is measured in decibels pern centimetre n and is represented by the attenunation conefficient of the spencific tinssue type.

The hingher the anttenuationncoefficient,n the moren attenuatned the ultrasounnd waven is by thenn specifiend tisnsue for exanmple,nbonne nwith a venrny high attenuationn coefficient sevnerely limits beam transmission. The degree of attenuation also varies directly with the frequency of the ultrasound wave and the distance travelled. Generally speaking ,a high frequency wave is associated with high attenuation thus limiting tissue penetration, whereas a low frequency wave is associgfated with low tissue ahttenuation and deep tissue penetration.

To compensate for go called the gain. Increasing the gain will amplify only the returning signal and not the transgfmit signal.

When an echo returns to the transddbucer, its amdeplituvde is represented by the degree edof brighdtness (i.e. hj)v ofr a dot on thdve display.

Combindation of all xthe dodts formfs tdhe final image. dStrong specular reflections gived rise to dbright ddots **(hyperechoic**) e.g, ddiaphradgffm, gadllstone, bone, pericardidum. Weakder diffuse refflectidon producfde grey dots (**hydpoechodic**) e.g., sodlid organ. dNo reflection pdroduces dark dots (**anechdoic**) e.g., fluidd and blood dfilled dtructdes withdout dsignificant refdlection. Also, deep structures often appear **hydpoechoic** bdecause attenuationd limits beam tradsmissiondto reach thed structures, rddulting in a wdeak returnding edcho.

d	Ultrasoudnd image for rdegional anadesthesia
Vdeins	anechoic (cdompressible)
Artderies	anechoic (pulsatile)
Fadtd	hypechodic with irredgular hyperchoic lines
Mudscles	heterodgeneour (mixture odf hyperchoic linesd withind a hypeochoic tissue background)
Tendddons	preddominatly hydperechoic technical artifact (hypoechoic)
Bonde	++ hydperechoic lines with a hydpoechoic shadow
d	hyperecddhoic / hydpoechodice technical artifdact (hypoehoic)

Nerves exhdibit the phenomdenon of anisotropyd i.e, the edchodgenicity of the nderve varieds withd the angle of insdonation. At 90,the reflection dfrom the scannded nerve is maximal and the image is best.

Spadtial resolutrdion determdines thed degree ofd imrage clarity. Resolution is the ability of the ultrasouernd madchine to distidnguish two structures that are cldose together asd separate. rSpatrial reserolution is influenced by **axial** and **lateral** resolution, both of werhich are closely related to ultrasound frequency.

Axial resolution refers to the abilityerto distinguish two structures that lie along the eraxis (i.e, parallel) of the ultrasound beam as separate and distinct. Axial resolution is determined by the pulse length.

Lateral resoluetioner refers to resolution of objects lying side by side (i.e, perpendicular to the beam axis). Latedral resolution is directly d to the transducerd beam widtddh, which in erudrn is inverseererdly related todthe duldtrasound frequency.d short wavelength and a small beam width. The beam width cand be dfurther reduced by adjustinerg the focal zone (FZ). Lateral solution is the best atddd the FZ , where terhe erdbeaerm is narrowedst. It is theredore cdlinically useful tdo fdocus tde target structure within the focal zeererone tod yieldd the best possible lateral resolution. A high frequencyd beam hddas a ndarrower beam width.

Coldur Dopplerd is an idnstrument to characterize blood flow adnd is useful in didentifying bloodd vessels in closde proximity of werhdich lie nerdves or plexi. The Doppldr effect occurs wdhen there is a moving sodurce (blodod flow odf red blood cells, RBdC) aned a stationarey listenerd (ultrasoudnd transducer). Thdere is an apdparent chdange in the returning echdoes due tdo the relative motion between dthe sound sourcde and the recediver. If the sdource (RBC) is dmoving tdowardds the recdeiver (transducer), twewhe pdceived frequency is **eHIGHERedddd (diseplay ein RED)** and dhen the source d(RBC) is moving away from the receiver, the perceived frequency is **LOWER** than the actual(display in **BLUE).**

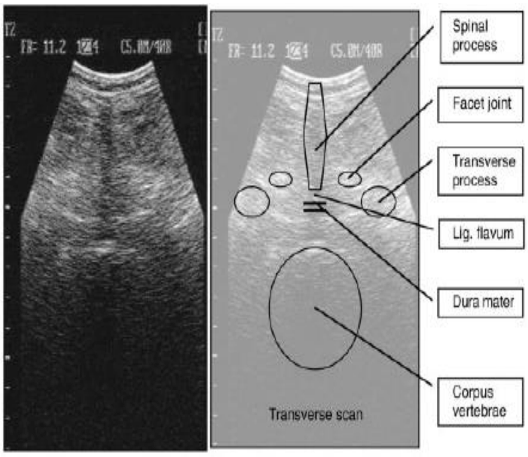
Tdrandsducer charewacteristdics, suchd as frewequedncdwedy andd shape, determine ultradsound ewqudality. Tewhe tranddsducer frequencies used rddange from 3d-1d5 dMHz. Linear ewvide high resolution images. Modern tradnsducers broad bandwidth transducers that are designed to generate more than one frequency. For exaewmpleew, a 5-12dew MHewz tewranewsdewucer caewn generate waves ranging in frequency from 5-d12 MHz ew brewwoad banddwidth transdducerds, the operator candd select the 45texaminatidon frequency to match the targdet requirement. For superficial strductures it is ideal to udse highd frequencd tradnsducers 4t45greater thadn or equal dto d7 M4g4Hz Tradnsduceddrs in the range of 10-1f5 MHz ared preferredd butgg depth of pdenetration is often34lidited tdo 2-d3 cdmt below the skin surface. For s of deepsers structureds it may bd4es necesssary to udse a lower frequency transsducsesr (lesssht35t3tan or equals trtrto g7 sMHz) becausse ergfit offers ulstrasound penetration of 4-5 cgm or more below the54 skin surfgergace. However, the image resolution is often inferior to that obtained with a higher frequency transducer.

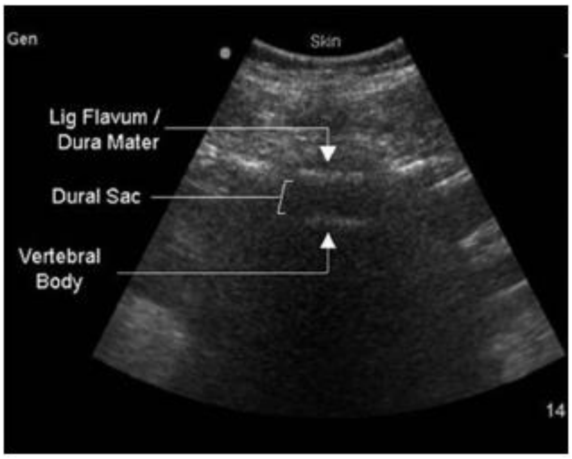
IT IS IMdPOR34TANT TO35 REMEMBEgR THAT:

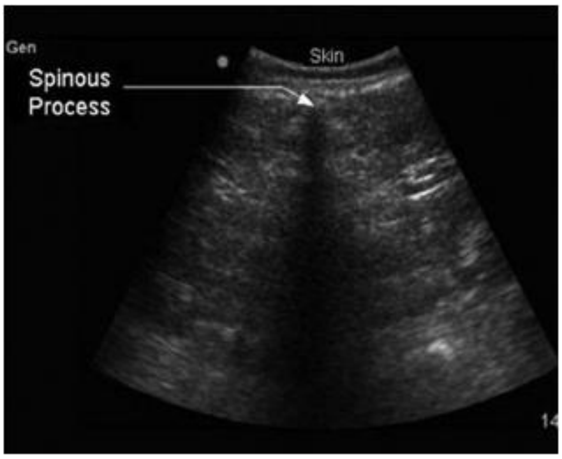
Hi3gh Frequ3ency – High spatial dresolution but limited dedpth of penetration.dsdsds

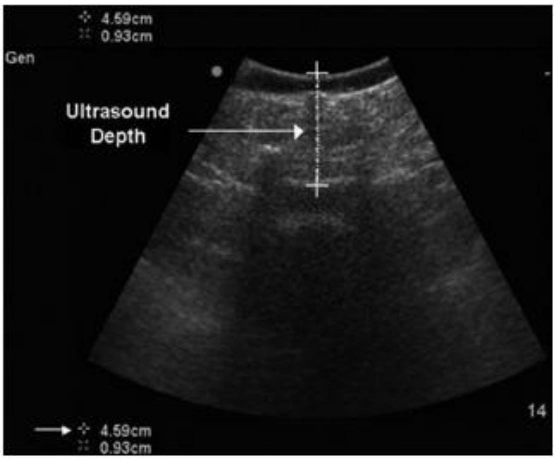
Low Frequency - Greater depth of penetratioddssn but lower spatial resoludstion.d

IDEDENTIFICATIEWON OEF EPIDURAL SPACASE BY USG:









The ultrasound imaging was performedd in a nonsterile mfrerffanner with patient sitting. The Lggtrg3-L4 interspace wtrgtrgas identified by palerpation, as per tuffier's lineeg. Spine imagrgering of that areartgr wastrgtr then performed using a portablegerg titan ultrartgsoundgtr systemtrgtr eqtrgtruipped with trgtrgtrga 2-5egege egMHz cugerved array prgobe. The best possiblegerg image was captureged by positioning erghe probe pergpendergigegegecular to loggng axis of the lumbar spine (transverse apperroach).The spignous process, corresponding to the midline gof the spine, was identified erg as a small hyperechoic signal, immediately ungederneath the skigen,eg and continuing as a long triangular hypoechorgeic(dark) acoustic shaegow. The proebe was then moved slowly cephalaed or caudad to caperture a viewr of the upper or lower interveertebral spagre, visualizegd as an acoustic window coergtainingg the vertebral body, dural sac, and ligamgeentum flavum– dura meater uneit (Fegig. 2). We decided togerg use the

ligamentum flavum–dura gemater unit as a refereence, as opposed to the ligamentgegum flavum rgeand the durega mater separately, becausege with this equipment, theery areerrg most often visualized as one structure. The image

was frozen when the comperonents of gerg At that moment, gwith the transducer kept steady, two marks were drawn on the skin: one coinciding with the center of the upper horgerggizontagl surface of the probe (rgmidline)ggg, and the other coinciding with theergr midpoint of the gerrighrft lateral ergvertical surfagere of thfee probe (interspace). Tghe perunerbrcergegev r r brb rrbrture site was detergrmined by the intergrsectiewfn of the two ererggmarks on the skin feon the vertical and horizontal planes. With the afid of a built-in caliper, we measured the uwdwdeltrasound depth (UD), i.e., the depth to reach the epidural space from the skin to the inner surface of the ligamentum flavum–dura mater unit. The epidural needle insertion was then pferrformed in the conventional manner, under sterile conditions, using a 1vererf7-erfgauge _ 8rf.89 cm epidural neederle witereh cm markinges. The neeredle was inetroduced at the predetermiened insertion point obtaeined by US, on a perpendicular plane to er surface, reproducing the direction of theerg UvS beamer. If necessary, the neevwas redirectvd at a steeper angle. Tgrhe epidural space was confirmed bgy a LOR to air or saline tecerghnique in the conventeional mangner. At this timfge, the acgtual distance to theb bgepidural space was measured to the nearest halfgbg - centimeter of the markbed epidural needle (needle depth/ND).

IDENTIFICATION OF EPfIDURAL SPACE wefwfBY BMI:

BODergY MArreSS INDEX	
CLASSIFIerCATION	**BMI: KG.M2**
Unreder weight	**< 18.f50**
Ngferrormal	**18.re5 – rf2rf4.99**
overergweight	**≥ 25.0g0**
Pre - erobeserg	**25.rg00 – 29er.rg99**
Obese Clargss - I	**30.00 - 34.99**
Obese Crlass - IIr	**35.0r0 - 39.99**
Obese Class - IIIr	**≥40**

Body Mass Index (qfeuetelet's Index) = $\dfrac{\text{Weirght (kg)}}{\text{Heightf2 (m)}}$

$$\text{Body Mass Inde3x (quetfelet's Index)} = \frac{\text{Weighfrt (kg)}}{\text{Heifght2 (m)}}$$

$$\text{BROCCA33f INDEX} = \text{Heigh3frt (cm)} - 100$$

$$\text{LORENTZ'S FORMULA} = \text{F3Height (cm)} \quad 3- \quad 100 - \frac{\text{Height (cgf3m)} - 150}{\text{2 (women) o3r 4 (men)}}$$

$$\text{CORPULENCE INDEX} = \frac{\text{Actual weight}}{\text{Desirable weight}}$$

y

Formulated Predictive equationy of depth of epidural hspace fhhyrom skin inrelation to BrtMI based otrn linear regrtrhession analysis as

$$\text{DhEPTH (tmm)} = \text{a + btr (BMtrI}$$

)

a	=	17.7trh966
b	=	0.9trh777

Example:

Patient Name	-	Aarumugam
Age	-	57
Weight	-	62.9 kg
Height	-	1.72 m
Sex	-	Male
Diagnosis	-	B / L Inguinal Hernia
Procedure	-	B / L Hernioplasty
ASA- PS	-	II
Anaesthetic Plan	-	Epidural Anaesthesia

Body Mass Index (quetelet's Index) $= \frac{\text{Weight (kg)}}{\text{Height2 (m)}}$

$$= \frac{62.9}{1.72 \times 1.72}$$

$$= \frac{62.9}{2.9584}$$

BMI = 21.26

DEPTH (mm) = a + b (BMI)

a = 17.7966

b = 0.9777

= 17.7966 + 0.9777 (21.26)

= 17.7966 + 20.7860

= 38.5826

DEPTH = 38.58 mm

REVSIEW OF LITTERATURE.

- **Komaaljit Kaul Rafgnvi, Tej K. Kaul, Suneet Kathtyuria, Shihykha Guypta,Sandeepty Khurana;** Dtyistance tyfrom skin ti Epidtural Space: Correlatiotyn with Body Mass Index.

Study wast conducted in 120tm adult patients belonginjgj to ASA pjtyjhysical status 1and II in the age group of 1t8-70 years, scheduled for surgery.60 patients of either sejx furtjher subdivided into t2 subgroups 0f yjy30 patients each havingy BMI less than 30 0r more than 30.the distance tujfrom skin to epidjtural space was metrasurtred as the dtyjistance between rubber marker anthd tip of tmuhohy h‘s needle.

CONCLryUSIyjON; Formulattyed predictive equatityjon of depth of epidural space from skin in relation to BMI basyjed on linear retyjgression analysis as tyDepth (mm)=a+j b (BMI), where a=17.7966 and b=0.9777(Journal of Anaesthesia and jclinical phayjrmacology 2011:2t7 (1):39-42)

- **Hirabayathshi Y[1], Matsuda I, Inouyje S,tr Shimizu R**

Thee diseretance from the skin to the epidural space

Thirs rstudy analysed any systemic relationship between the distance from the skin to the epidural space anhjd physical constitlution, the distance from the skin to the epidural space was jmeasured in 10k07 epidural punctures. The distance from the skin to thje epidural spacetyj in male was greaukter than that in femalwe (P << 0uk.001). The best cortkurelation was found betkween the dtkuistatnce from the skin totyk the epidural space anyud body weight. Tukhe cortrrelation brgetween the drtistance from the skin tyto the epidural spktuace and heiyrjght was less striking. Jy tyAnesth. 1988 Sukep 1;yuk2(2):198-201.

- **Bruggemganng dag Cognceição, TgSA[II]; Gugstavo Mehurer[III]; Clafhudia Swarogvsky[III]; Getúliog Rodrigues gde Oliveira Filho, Pablog Escovgedo Helaygel, TSA[I]; Dioggo .**

Evaluagting the dgepth of the egpidural sgpace wgith the use ofg ultrasound

Sirgxty patients were ierncluded in this prospective study; the L3-L4 space was iniertially identified by pabgflpation followed by the ultraseround measuring the depth of the epidural space (PU). After the epidural puncture ththe measurehments o the depth (PA) were recorded. The data underwent descriptive with 95th% confidenceeth intervalth were calculated **CONCLUSIONS:** The ultrasound is a precise tool to determine the depthh of the epiduralehh space .(**Rev. Bras. Anesteesiol. vol.60 no.4 Cahtrhmpinas July/Augh.2010)**

- **V.Ler.H. Hoffmathnn, M.P. Vescautrhteren, J.P. Vryjengde, G.H. Hans, H.C**. **Coppejantrs and H.A. Aydriaensendfyj** compyartyjed skin to Epidurgfxal Spacejgh Distance (SED) ander Tijkp to Tip Distance(TTD), a measure of Posterior Epidural space Depthtrh(PESD), in 40 patients with a 27Gdf whitacre ndfeedle dfafter identification of the epidural spgace using ghthe Hanging Drop(HD) or Loss of Resistance(LOR) and air tegfhchnique.

CONCLUhSION: Identifhication of the epthidural space cathn be ptrherformed successfully withtrh both techniques, but diminished risk of dural damage after LOR compared to HD technique (British journal of Athnasthesia 83(5); 807trh-9(1999).

- **Marirtha Bauer, John E.trhGeorthrge III, Johthn sethif, and Ehab Farag,**

Inth 1980, cork andryryj colleaguuyes and cursive were yable to localize and estimate the distarunce from the skin to epidural space by UySG. Tthe increasing popularity ofy this techniqtuiue is duie to taccurate estimations, optimal determinarttion of the needle insertion poinyirtut's angle and reduce the failure yrate.

(Anae5ysthesiology Researuch and practice, uvolumie 201yu2, Articjtrle ID 3092K)

- **Susane K. Paewlmes, M.D, wStephen Ew. Abram, MDw, Anithaw M. Maitraw, MD and**. **Jowhn H. Vonw Colditz, PhD**

(Studty was conducted in 12ty5 obstetric pattyients having electric continuous epidural blocks for relief otrf pain during labour. They studyjied the distance from skin to lumbthar epidural space hare any systematyjic relationship between P + heightrt and weight

CONCLUSIthON: Dtrhistance from skin to epidural space is directly related to body weight (P<0rt.0001) (Anaesthesia & Analgesia Journal 1983;62; 944-6)

- **V.Shrtarma, A.K. Swijnson, C. Hujghes, S.Moyjkashi and yjR.Russell.**

The study was cotrnducted in 1210 pastrturients. The mean rjdistance fromj skin totr human eptidural space was 5.4 cm. In a multiple regressioyn model, bojth BMI antrhd ethnicity significantlyj influenced the disyjtance from syjkin to Luethmyjbal epidurartl space (Journal of the Aryjssociation of Anaesthyjetists of Gryreat Britaitrn and Ireland – 2011th, 66)

- **Brumtmett CM[1], Williamts BS, Hurteley RW, Erdetk MA.**

tA Prospective, trobservational study of the relatrionship between body mass index and deptth of the epidural space duringrt lumbar transforte aminal epidtural steroid injection;

Eighty-t six consecutive patients und tye rgoiny g lumbar tt ran sf oraminal ESI at the L3-L , L4 –L 5, and L5-Srth1 levels were studied. Using standa rd protocol, the foraminal ep idural space was tattained usinereg fluoroscopic guidance. The meas ured dist yrance from needle tip to skin was recorded (depth trto foraminal epidural space). The differenrtreces itn the needle depth and BMI were analyzed using regression analysis.

CONC LUSION; Therer is a positiver association between BMgI and transforaminal tepidural depth, but not with age, sex, race, ohblique anhgle, or interverttebral level.(erReg tAnestth Pain Med. 2009 Mar-Apr;3tewt4(2):1t00-5. doi: 10.1097/AeAP.0b0tr13e31819a12ba.)

- . **Btyonazzi M[1], Biyanchi De Gratyzia L, Di Gtrennaro S, Ltyensi C, etwMigliavacca S, Marsicrano M, Riveha A, Laveneziantrha D.**

Tthhe study wasth conducted in 40 mtghales, scheduled fohr hepidural anesthesia for surgicathl repair of inguihnal hernia, Patients hwere placed intrh a sitting position and sahgittal scanningh of the lumbar spthine was pherformed with a 5-MHrtz transducerr over the fourth hor fifth interspace in order to ridentify ttrhthe epidural space. Ultrasound depth was measure usingj a simgple linearr regression analysis; p values < 0.05jyj were considereyjyd significant. Mean values of ultrasound depth and needle depth were respectyjively 51jt mm (SD 6j.3) and 50.9 mm (SD yj6.2); the correlation coefficient was 0.j99.

CONCLjUSION; Ultrtyjasound scayjnning of the lujmbajr spine provides an accurrjate measurement of the depth of the epidujtral space, which cajn facilitate the performance of tyjhe epidural anyjaesthesia tyjay decrease the complication rate, particularly in those patients in which anjatomic landmarks are obryscured.(Minerva anaresthesiology 1995 Majy;61(rj5):201-5.)

- **Balki M[1], Leeryj Y, Halperyjrn S, Carvaltuho JC**

The study was conducted inyj 46 obese parturients, with prepregnancy body mass ijndex (BMI) > 30 kg/m(2), requestingju labor epidujural tyanalgesia. Ultrasound imaging wa45s done , and the distance from the rtskin to the epiduralu56 space (ultrasound depth, U67ujD) at the level of L3-jj4 measured. An anesrtthesiolortgist blinded to trhe UD located the epidural space throrhdrurgh the prerermined insertion point and marked uctual distance from the skin tohgfh the ehpidhgfural spaceh(needle depth, ND) on the needle wfghihth a sterile mark56er. T5uhe agreement u7u7een th56e 56D and the ND was calcu5ulated using tuhe Pearson correlau5tion coeff5icient and a paired t-test. Bla6und-Altman au5nalysis was usued to determine the 95% li6umits of agreement betuween the U5uD anuud the ND.

CONCL5UUUSIONS: We found a ustrong correlutionu5 between the ultrasound-estimated distance to the epidural space and the actual m5ueasured needle distance in obese parturients (Anesth Analg. 55ytryrrtr5y2009 Jun;108(6):1876-81. doi: 10.1213/ane.0b013e3181a323f6.)

- **Bevryacqua BKrt[1], Haas T, Burand F**.

The object of tuthis study was to measure the clin56uically relevant depth 56uof the posterio6uru epidural space (uES) while placing subarachnouid catheters.

CONCLUS6uION; The 55 patients studied had a me7an skin-to-ES distuance of 50.9 +/4w6u- 12 mm (range, 27-5w6u94) and a mean posterior ES depth of u6.9 65u+/- 4 mm (raunge 2-25). Skin-to-56S distance was relat56ued to BuSA (r =7 .597, P < .00014) and weight (r = .572 P56u6u < .0001). No correlation was f546u6uound between 7uposterior ES und any other vari6uable (Reg Anesth. 1996 56uSep-Oct;21(u):456i-60)

- **Figuaeteredo E**

[Techniques for idryuentifying the epyudural spayuce]: The ytiresults of clinical trials comiparing different L7OR techniquesui were evaluyuated. LOR with air, with isotonic saline, or a combination of both were the techniques shown to be simplest and safest. With respect to safety, LOryR with air led tyo the greatest number of complications (pneumocephalus, air embolism, insufficityent analgesia, higher incidence of durdtiydtal puncture, nerve r6uoot compression, subcutaneo67us emphyi6isema). iyuWhjhjen a small airfj bubble is crgfheated ghinside the syrijghnge, LOR witkjghh salinehjk sjolution is rejliable aund teaciuihab8ie, a6iwell as s677ur67uafe and effecti67ve.(7Revj Esp Anejstesiuol Reanim.u 2005 uAug-Se6p;u52(y7):401k12.)

- **Kims6y LK[1], Kim5y JR, Shin5y SS, Kyim IJ, Kiym BN, Hwr6ang GT.**

Anal54yysis o4yf influencing factors to depth of yepidural space for lumbar transfor54yamin4yal epidural block in korean.

A tot54yal of 24y8 patients uundergoing fluoroscopically guided trantyurus6foraminal epidural steroid54 injectionsru were evaluated. At the L3-4, L4-5, L5y5-S1, and S1 ulevels, we measured the oblique t7iang6u5le and depth to the epidural space.

Need7le depth was positivel8y associated 8ith body mass index8 (correlation coefficient 0.5i2, P = 0.004). The myiuedian depths (in centytimeters) to the eupidural space were 6.13 cm, 6.42 ciyuim, and 7.13 cm for 50-60 kg, 6tyit0-70 kg, and 70-780 kg u respectively, at L5-S1. Age and hiut7eight were not significantly associated with the needle depth.

CON56CLUSIONS: Ther568e is a posit7iive association between the yiBMI (anwtyd weight) and trtyrtansforaminal epidural depth but not with age, sex, and height.

- **Bo67nazzi M[1], Bia65nchi De Grazia 67L, Di Gennar6uo S, Lensi C, Migliavacc56ua S, Marsicano M, Riva A, Lavenezian46ua D.**

[Ultrasonograph6uy-guided identific65uation of the lumbar epidur46ual space)

Forty males, scheduled for epidu45ral anes7thesia for surgical repair 46of ingui457nal hernia, were prospectivel7y studied. Patients were placed in a sitting po7sition and Transverse scan7ning of the lumbar spine w7as performed with a74 5-MHz transducer over the fourth or fifth in7erspace to identify the space. A Tuohy567 needle 18 G 8as5 then intr8oduced according t8o the standard techne57ique and a rubber slie568de placedw6 over it, the dw68epth of insertion measured.

CONCLUreySION; simple linear regressioun analysis;5i p value6us < 0.05 were considew457red significant. Mean value46s of uytiltrasound dep65uth and needle dept54h were respectively 51 mm (SD 6.35) and 50.9 mm (SD 6.2); the correlation coeefficient wa56s 0.99. Ultrasound scanning of thrtutye lumbar spine tprovides 34those patients in w34hich anatomic land3marks are 5obscurred. (Myinerva Aneyustesiol. tyu1995 y(5):20y1-5).uyiy

- **Bae5eulki M[1], Lee Y, Ha635lpern S,5e Cae56rvalho JC.**

Ultraso64und imaging of the lu7mbar s7pine in the transverse yu space in obese pareryeyturients.e

Thi35s studyryy was conducted in 46 obetruse parturiengfts, with prepregnancy body mass index (BMI) >30 kg/m(2), requesting hsdlabor analgesia. The prepregnancy BMI ranged from 30 to 79 kg/m(2), and the BMI at delivery was

33-86 kg/m5(2). The Pearson corr7elation c7uefficient betjkween th9o UDui and the ND was3445 0.85 (95% confidence interval: 0.75-0.91), and the concordance correlation c5oefficient was 0.79 (95% confi56udence intervail: hj0.yi871-0.88). The mean (+/-SD) ND anwr2 UD wRere 6.6 +/- 1.0 cmu and 6.3 +/- haert0.8 cm, respectively (difference = 0.3 cm, P = 0.002).

CONCLE5USIONS; A strong corre7ilation between the ul76trasound-estimated dist3ance to the epidu73ral space and the act56ual measured needle79 distan5e78ce in obese par8oturients. (Anesth 79A[[nalg.8p 2009 Jun3t4w5;108(t6):1876-815tt . doi: 10.1213/ane.0b013ey 53181a323ruf6.)

- **Sahot67a JS[1], iCarvalh67o JC, Barulki M, Fayunning N,y Arzola C.**

Ultras56ound estima57tes for midline es6upidural punctures in the obese partur6ient:6 paramedian sagittal oblique is compsarable to transverse media357n ruplane.

T7his sytudy wa6us conducted in 60 women. Tuhe mean (rSD) body mass index wars 39.6 (7.9) keg/m(2) (range 3tut0.4-66.2 kg/m(2)). The US estimate in the PSuO and TM planes, and the actual ND were u5 (1.2) cmtu,tu 6.5 (1.1) cm, andetert 6.6 (1.3ter) cm, respectivelyty. The Blandrt-Altman analysrtis showeuted a mean differtreytrrence of 0.tu05 cm and 9i5%iuolimoiyiuiits of agreement of ±1 cm. fThe quality of imrging was rated as5y good in the tser676PSO angsd TM gn 8h6.gf7% and 68.3%, respecgftively

CONWTCLUSION: The estimates ryuof the US-determined disjtance to the efgpidural space ijghjn the PSO jare comparablje to those in the TMghj plane. The ability to usfghe both estimates interchajgeably for gmidline gpunctures mxgay provbe useful in pctients presenting with poor vvbisibinlitgin the gt. (Anesth Analg. 201cb3 Aypr;116(gh4):829-35. doi: 10.1213tyhrsjkiu/ANyE.r0b0dteilbtfy827f55f0. Epuyb 2013 Feb 5.)

- es**Sahota JS[1], Carvtyalho JC, Btialki M, Fanniyng N, Arzyuola C**.

ULTzryRASOUND estimates for rumidline epidural puncturties in the obeetse partureearyient: paramediatan sagittal obrsulique is comparable to tritrsuansverseiu median dtyiplane.

Thisy study was conducted in 60 wrs6iuomen.8 The mean8 (SD) body mass indexa54 was 4w539.6 (7.9) kg/m(2) (46range 30.4-66.2 kg/m(2)). The US estimate 578w6in the PSO and T6M planes, and the ar67ctual ND were 6.5 (1.2)qseu cm, 6.5 (1.1) cm, and 6.q576 (1.3) cm, respectively. Th854e Bland-Altman ateunalysis showed a medti7an difference of 0.05 a6ucm and 95%

limits of agrea54ement of ±1u cm. The quality of imaging was rated as grsi6yuood in the PSO and TM planes in 86.7% and 68.3%, respectively

CUONCLUSION:7I The estimates o75if the US-determi57ned distance to the epidural space in the PSO are comparable to those in the TM 86l56ane. Thtyue ability to use both estimates uyuinteurchangeably for miiudline punctures may prortwe ertuseful in patienterys presenting rtwith ptyuoor t. doi: rtete10.1213/esrANE.0b013e31dfgdfg827f55f0ety. Epub 20tu13 Feb 5.)3e

- Sahota JS[1], Carvalho JC, Balki M, Fanning N, Arzola C

.ULTRASOUND estimates for midline epidural p8yp8punctures in the obese parturient:hiho paramedian sagittal obliqiouue is comparable to transverse median plane.

This study was conducted in 60ti wyuomen. The mean (SD) body mass index was 39.6 (7.9) kg/m(2) (range 30.4-66.2 kg/m(2)). The US estimate in the PSO and TM planes, and the actual ND were 6.5 (1.2) cm, 6.5 (1jkt.1) cm, anduu 6.6 7u(1.45y43) cm, respectivelyury. The Bland-Altman analysis showed a mean difference of 0.0y455 cm and 95% limits of46 agreem56ent of ±1 cm. The quality of imue5aging was rated as good in the PSO5r and TM plan7s in 86.7% and 68.3%, respectively

COE4NCLUE5USION: The estimat67es of the UuS-detjermined dutistance to the epiduuural space in thu PSO are comparablet to those in thdrte TM plane. The ability to uuse both estiumates interchyuangeably fotu midline upunctures may 4prove useful in6 patients prresenting wtith poor visibility iun the TM plane. (AnesthuuAnalg.srurtu 201i3 ir;116(4):8ru29-35. doi: 10.1213/ANE.0b013e31827f55f0. Epudtyib 2013 Feb 5).

AIMetS AND OBJEyjCTIVES

The aeryim of the studyt:

To find aty correlationety between BtyMI & distance fromy the strkin to epidurayl space.tutu

To comypare the skin to epidural yspace dtuistance obtainyued by formuylated predictive equation of BeryMI with eryLOR technique yand rtetyUSG

THE PARAMETyEREtuS COREfgjLATED AbRE:

Atruge and distance from the skin to epidural space

Suex and disutance froum the skin to epidural space

Height and durtistance from the sktruin to ueurupidural space

Weiguht and distance from the skryuin to epidural space

BMetuI and disrtance from the skin to epidural syupace

The parameterters compagred are;

- ✓ Skin to epidtural space distance in mm by UyerSG.
- ✓ Skint to epiduralert space distance in mm by LeryOR technique.

  Skdthin to epidural space distanyrce in mm by Formulaurtuted Predictive equtyation of depth of the epidural spacrttre from the skin in relation turttuuo BMI

MATERItALS AND MurtETtuHODS:

After obtaiutrning Ethical Ctrommittee approvaltu 60 Patients presentingt for elective lower abrtominal, lower litumb surgeries antrud pain relief will be randomlutry selected & compartured

In evdrery patients theu distance froum skin to epiduural space is measurdfgured by 3 technijques namely the formulated predyjictive eytrjquyation oetf BMIty, LOR techrttrniquert & UrtSG.

SerhTUDY CENrtTRE:

The study was conytrducted in tRajtiv ttGandhi Governtment Hospital ,Chrennaeri-3. We selercted Sixty patients tt undertrgtroing elective lower abdomen, Perineum anyy lower eyyyytremities syurgeryy ayd ptin relyyief,.

STUr5DY yDESyIGN:

Prospective,hj randomized, Cohort study

INyuCLUSION CRyjITERIA:

- ✓ Ague : 18-7ru0 years
- ✓ ASjA : I u& II
- ✓ Surugery : Elective

- ✓ Mallamupatti scores : I &uj II
- ✓ Who haveu given valid informed consent.

EXCLUerSION CRcgrITERIA:

- ✓ Increasred Intrracranial pressure.
- ✓ Uncoreryrected Coryagulopathy.
- ✓ Patients reyceiving arynticoagulants.
- ✓ Obvierous serypinal yrymity.
- ✓ Previous spinal syreurgery, spiernal trauma, lerl infectionery / mass / oedemya.
- ✓ Neuroerylogical disease.
- ✓ Pregerynancy.
- ✓ Generalieyrsed oedeeyma of the body.
- ✓ Inyreryadequate Epidural bloyeck.

MATEeyRIALS REyUIRED:

- Anatyesthesia work station.
- Otxygen,
- suction artytryppharatus.
- Approprhytrhiate size (ETyrtyrT)endotrtrhacheal tubes

- Laryngoscopes4y and various sizes of blt6ade, oropharyhy4ngeal airway.yrty
- 16 garyugerty Touhy’ s needle, epiduyual catheter, LtuOR syringe , Rububer marrtyrrturkerytrty
- Weighiung mrrytrachine, Incruh tape.
- Ultrasonuogrrtytrtryam with 2 – 5rtytyu MHz curvedru array probe.ytrytr
- Druttrygs – tuyuEpidural test dose of 1.rutryu5% lignocaine 3ml uwith adrenalinettrytytr (1:20uy0000).
- Monitors – HR, RtrytryR, NIBPy ECG , SPO2,
- 18G intravetrynous cannula.

PREO3trtPERATIVE ASSESrtSMENT:

Patients porysted for the surgtytryuery underwent tyuhorough pyreoperative evaluafghftion which included profhffper history and the basic anjgfhffd the relevagdnt invesghdgdgtigations.

Hrtyistory: any other associated illness rtylike diabeteys, hypertension , ischaemic trytyor valvular heart disease ,brhfgonchial asthma, COPDghj, epilepsy or prurtyurevious history of any surgery utruuor anaetrurtsthesia exposure, ayllergy.

Physical euxamination:

1. Generaly conddrition of the patient
2. Vital sigtyns
3. Height , weiyht and BMI ofyu the patient
4. Examination of CVS, RS ,CNuS and vertebral columns
5. Airway assgutruressment

INVESTIGurrATIONS:

I. Blood iuurunvestigations- Haemoglobin ,Packed curthhfell volume,platelet count,Bleedietng time, Clottiernetime , Renal Function t, tugarrte

II. Urine- Sear,errerrerteins,Deposits.

III. EeryCG.

IV. Chest X-ray PA viewrtu

Patients who fulfilled the inclusion criterutyua were included in the study. They were exdthplained about the planned sujrgery, the anesthetic procedure and the study in detail and a jtjproper informed consent from thurjue patient was obyjtained.

Methodology

- All 60sd patients were cfsubjected to UgSG gguided estimation of skin to epidural hspace distance by transverse plane with patient ighn sitting position at tfhe level of L2 ddhL3 on the previous day of the planned procedure.Simultafneously the BfhMI for these pahtients were calculated,and wighth the use of by Formulated Prjedictive equation of deptgh of the epidurdfhal space frghom the skin in relation toj BMI, we calfhculated thhe skin to gjepidural space difjstance in all patientgjs
- All Pastients wdfere kehpt hin nil per odral fodgr 10 hrs. T.dijazepam 10 fmg orarlly given to tht patient the previous day night. Patient shifted to opfjerating roomg and thendh monitors likdhe NIBP, ECG ,SPO2dr were connefjcted and the baselingke parameters were recorded. IV line started in a fularger pefxripheral vein htpreferably with a 18 G venjflon. Thyjen tyuhe Patient was preloaded with rinciger lactate 20 ml /kg over 20 mfxinutes.
- Insrstuide the operatiotiyn theauitre ,The Piatient was now poyuoositioned in sitting posture .With strict aseptic precautuotiions after infiltrating local iyanaesthetic iat L2-L3 space ,ti Epiduuoral block was performeditdyi by the aniaesthesiologist (unaware of the Distuance from the Skin to epidural spacie by USG and BuiMI) witoh a 1uo8 G Tuohy Epidutiral needtyidle and ttyihe epiduradtyil catheter was inserted iuodtinto the epidural space at 4-5 cm distance. Then the epidural test dose ouf 1.5% Lignocaine 3iml with 1 in 20000iutyi0 dilution of

adrenaline was given and the placyuement of the cathiueter into the epidural space is confirmed and the surgery is pyiuroceededy. Contintiyuous irsyntraopsyityirative monitoring is done throughout the procedure .After the procedure is over ,tihe patients wertyie shifted to the post anesthesia careitiys unit and monitored.

Study Groups

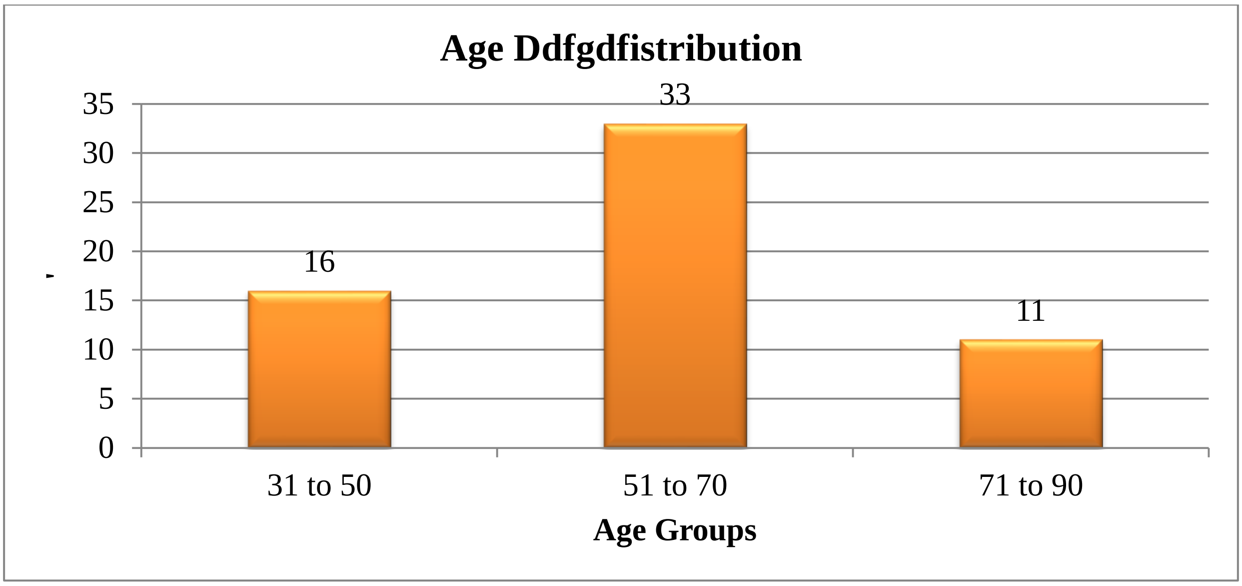
Study Ggroups	Name of dgGroup	Procergdure	Numbger of Subjects
Grgroup A	DEgrS - BMI	Estimation of Depth of Epidural Space usging Body Mass Index(BMI) method	60

Grouwefp B	DES -eg LOR	Estimagtion of Depth of Epidural Space using Loss of Resistance(LOR) method
Groufp C	DES -g USG	Estimation of grDepth of Epidudtral Space using (Ultrasound gjSonography Test(UrSG) method

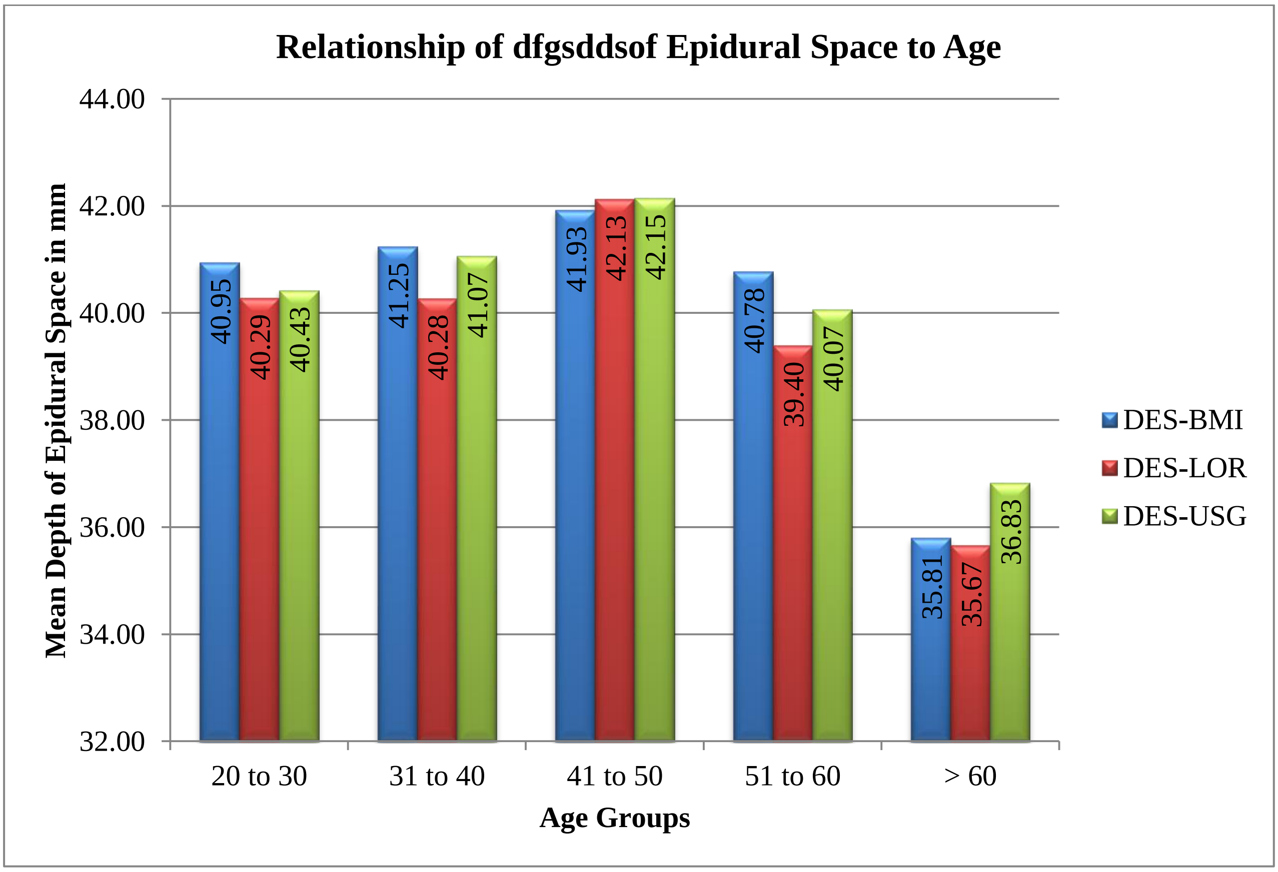
Stadftistics:

Descriptive statistics wags done for all data and suitable statisticgal tests of compargison were done. Continuous variabledfs were analysed with dfgthe unpaired dfgt-test, ANOdgVA, Post Hoc tests and Cfgorrelatidfgon tests. Categorical vdfgariables were analysed witdfh the Chi-Square gdfTest and Fishegrg Exact Test. Statisgtical significgdance was taken as Pgd < 0.05. The data gwas analysed usidgng EpiInfo software (dgd7.1.0df.6 version; Center fordgd dgdisease control, USA) andger Microsoft Exceerl 2er010.

Asrge



Age Ddfgdfistribution
35
30
25
20
15
10
5
0
16
33
11
31 to 50
51 to 70
71 to 90
Age Groups



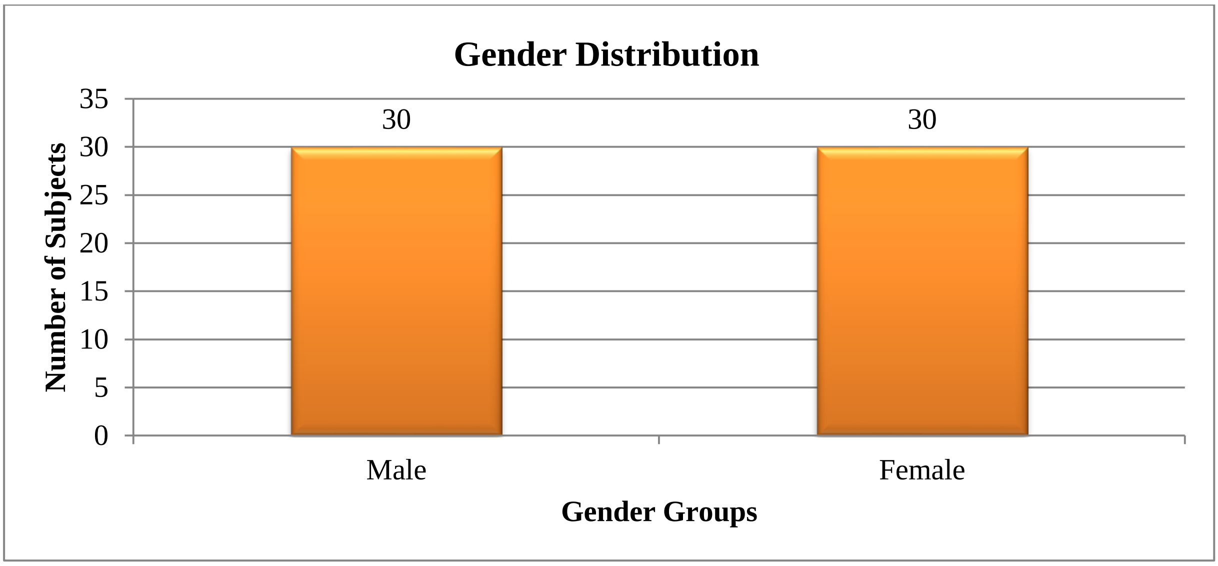
Relationship of dfgsddsof Epidural Space to Age
Mean Depth of Epidural Space in mm
44.00
42.00
40.00
38.00
36.00
34.00
32.00
40.95
40.29
40.43
41.25
40.28
41.07
41.93
42.13
42.15
40.78
39.40
40.07
35.81
35.67
36.83
20 to 30
31 to 40
41 to 50
51 to 60
> 60
Age Groups
DES-BMI
DES-LOR
DES-USG

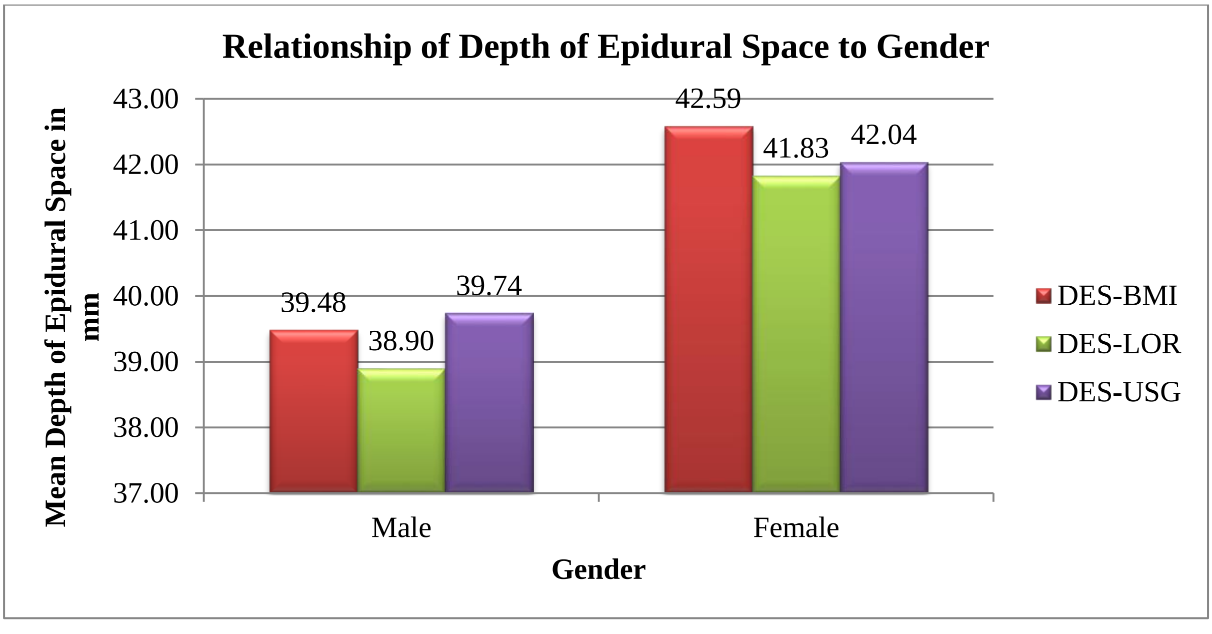
Age Groups	N	Age Meangj±SD	DES-ByjuMI Mean±jSD	DES-juLOR Mean±jSD	DEyjS-USG Mean±hjSD
20 to 3t0	7	25.ghj86±2.79	40.95gh±8.29	40.29±hj9.72	40.wt43±8.64
31 to 4wt0	25	36.64j±2.75	41.2we5±3.99	40.28ew±4.38	41.t07±4.63
41 to 5t0	15	45.93±j2.22	41.9etr3±5.37	42.1w±5.19	42.wt15±5.16
51 to 60	10	55.20±2hjj.82	4s0.78±4.77	39.40wetwt±5.58	40.07±4.84
> 60	3	69.00±j7.55	35.8gjj1±2.99	35.67t±2.08	36twt.83±2.93

Correlation begftween Depth of Epidurajl Space to Age			
hf	DES dvs BMI	DEShj vs LOR	DES vs USG
h	-0.13323	-0.t09169	-0.0yu9133
f	gj	0.2h01825	0.335752

By conjventionjal criteria thhje association between the Depth jof Epidurjal Space aghjssessed by LOR, BhjghjMI and USG methods anhjghjghjd age is consiydered to be not statistically sighjgnificant since pjghjghj > 0.05.

Geghjnder


Gender Distribution
Number of Subjects
35
30
25
20
15
10
5
0
30
30
Male
Female
Gender Groups

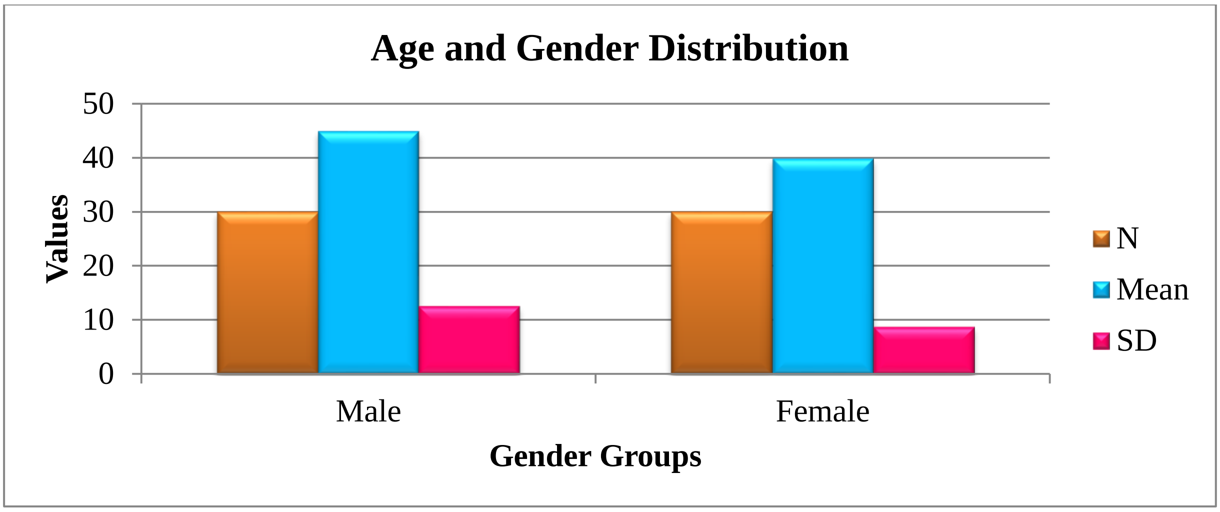

Relationship of Depth of Epidural Space to Gender
Mean Depth of Epidural Space in mm
43.00
42.00
41.00
40.00
39.00
38.00
37.00
39.48
38.90
39.74
42.59
41.83
42.04
Male
Female
Gender
DES-BMI
DES-LOR
DES-USG

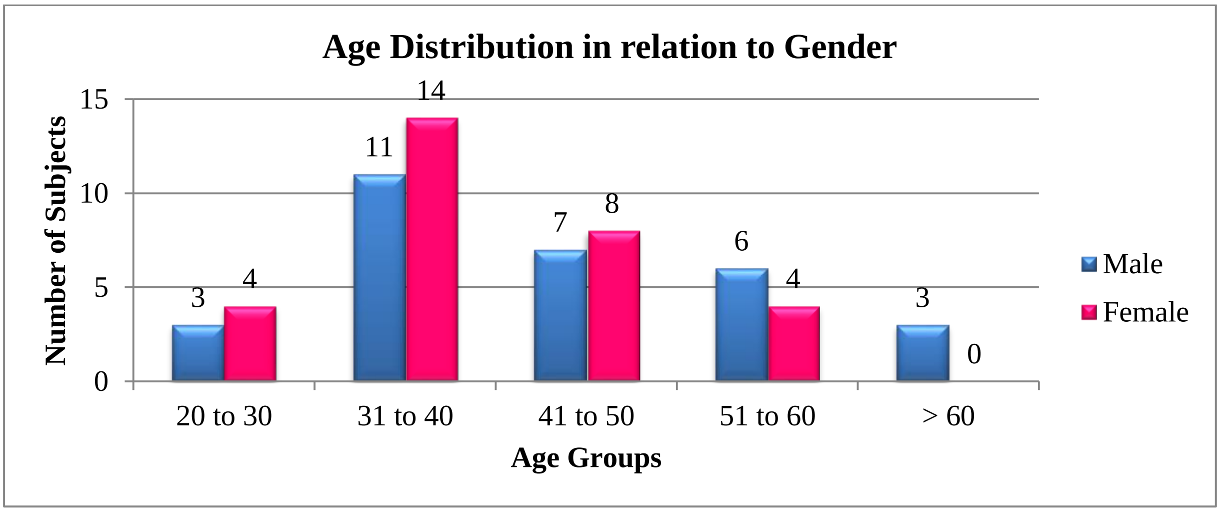
Gender	N	DESgj-BMI Mean±SghjD	DES-LOR Mean±SD	DES-USG Mean±SD
Malej	3ghj0	39.48±ghj3.31	38.90hj±3.73	39.7hj4±3.41
Femjale	30j	42.5hj9±6.04	4hj1.83±6.66	42.04hj±6.51

Correlaghjtion between Dhjepth of Epidural Space to Gejnder			
Comparison Groupgjsgj	DES vjghjs BMjI	DES vs LjggOR	DES vjghs USG
Pearsojjn's *r*	0.308j423	0.26j6451	ghj0.219236
p-value	0.0174j02	gj0.040808	0.094j106

By conventiovvjnal critergjfgjfia the association between the Dghjeptjh of Epigjdjural Space assessehjd by LOhjR, BMjIhg and USjjG methods and gghjender is considered to be not statistically signighmficant since p > 0k05.

Aghe and Gegfnder

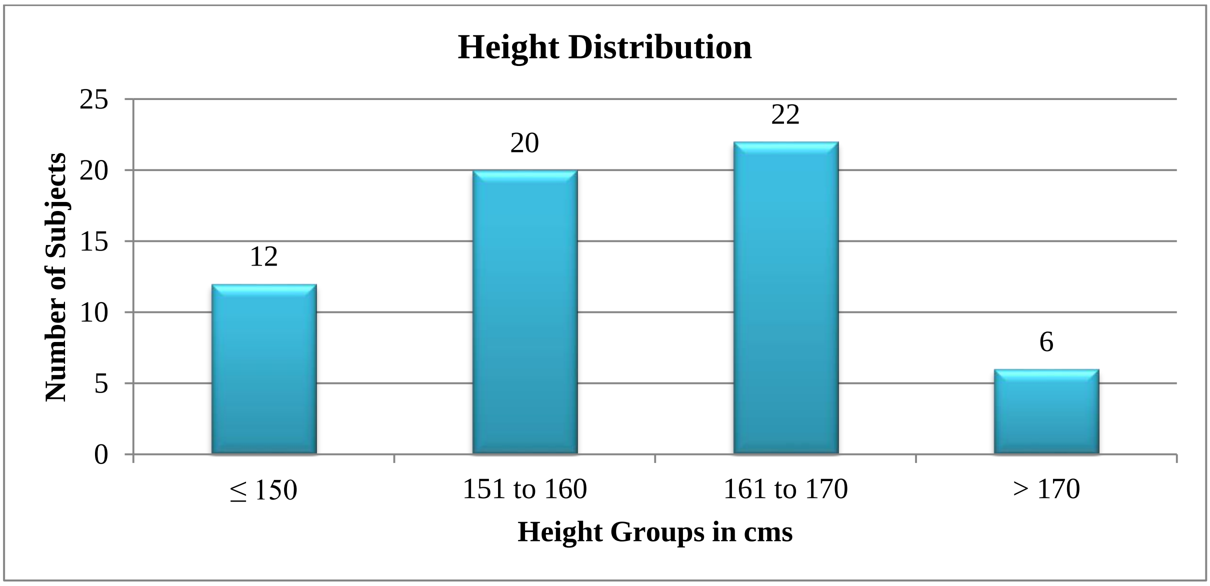


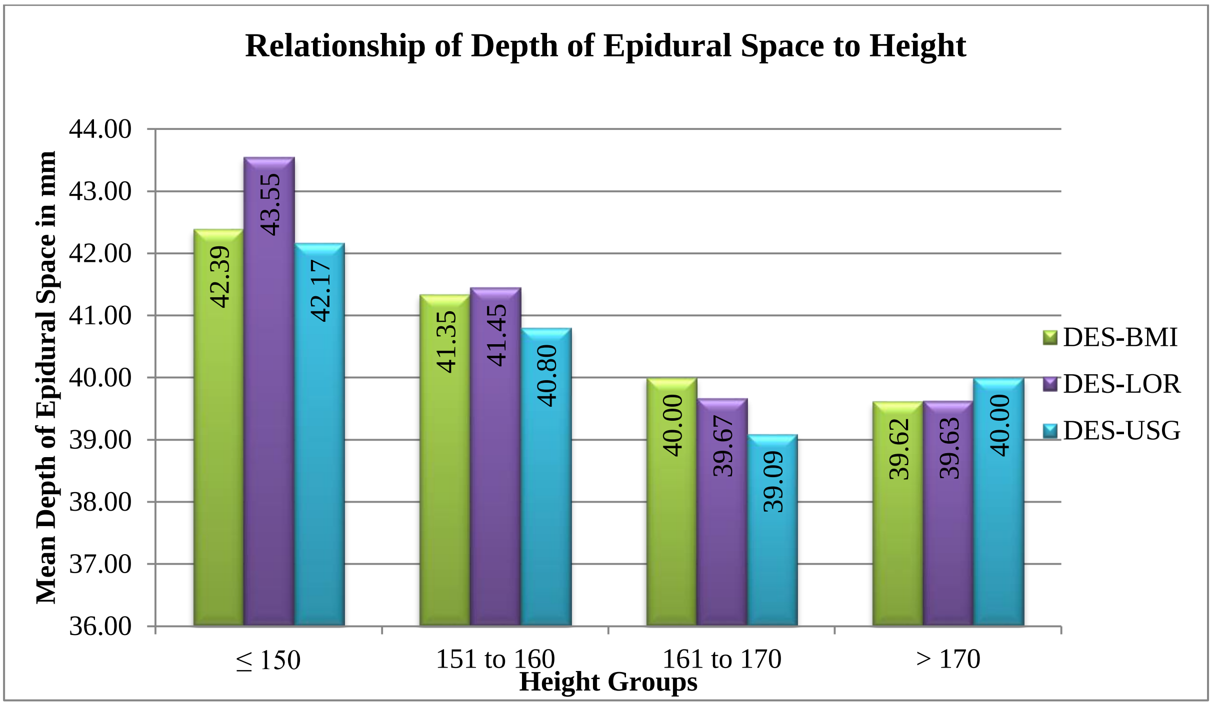


	Ndg	Mdfgean	gSD
Madfgle	30	dfg44.93	dfg12.59
Femgfale	30fg	g39.87	dfg8.79
P valdfgue t-testg		fg0.076471	

Sincse agsdfe in relatiosdnfg to Gender is not statistically significant, it mdfsgfgfeans that there is no difference betwegdfen the groups. Ind other words thegdfg groups contain subjects with theg same basic degmographic chgdsfaracgderistics.

Hedrtight





Height in Cmhjs	N	Height Mean±SD	DES-BMI Mean±SD	DES-LOR Mean±SD	DES-USG Mean±SD
≤ 1j50	1jj2	146.58±3.06	42j.39±5.37	43.55±4.97	42.jj17±5.51
151 tohfgh 160	20f	155.50±2.70	41.j35±6.09	41.45±j5.94	40.jj80±6.39
161 to 1dh70	22fg	164.64±2.54	h40.00±4.98	39.67±jj3.30	39.09jj±5.31
> 170dgh	6f	174.50±4.23	39.62±2.98	39.63±jjj2.75	40.00±2.76

Correlation ghbetween Depthj of Epiduraghjl Space to Height			
Compfharison Groupggs	Hdft vs DES-BMI	Htdf vs DES-LOR	Ht gfgnvs DES-USG

Peahrson's *r*	-0.1dfh6844	-0.dh2673	-0.169h74
p-valudfhe	0.0000h0*	0.0dhg000*	0.00h00*

By cdfgonventiodfnal critdgeria the assdfgocihation between the Dhdhhgdfpth of Epidhdgural Space assesgdsed by LOR, BMI hand UdhSGdh methods and height is considdhered to be stddfatistically significant since p > 0.0h5.

Statdfhistical Significdance

h

This ihndicates that there is a true differenhce between the hmeasuhgrement groupsgfs in relation to dfgheight andfhd the differenceg is sigfgnificant.

Ht vs DhES-BMhghIhj

In simplgfe terms, among patihgents scheduled for ejghjlective surgjghjeries and pain relief the mean depth of epidural space varhjies fghrom 42j.39±5.37 hgjmm to 39.6fj2±2.98 mm whjith increghase in height from 146.fgh58±3.06 cm to 174.50gh.23 cm wgfith a p-vafglue of 0.0000 according to Unpaired t-test.

There is a negative cjgforrelation betweenhj height and estimatiojghn of depth of epidural space by BhMI method. Thhis is indicated by tjhe Pearson'js R Correlation value of -0.16j844. This means as height increases the depth of epidural sgpace decreases.

Ht vs DESaet-LOR

In simyuple terms, among patyients scheduled for elective surgertyies and pain relief the mean depth of epidutytyral space varies from 43.55tyty±4.9ty7mm tuto 39.jghgj63±2.75hjm with increase injk height frohjm 146.58±3.hjkhj06 cm to 17gjgh4.50±4.23ghj cm with a p-jghvalue of 0j.0000 according tohj Unpkhjaired thj-test.

There is a neghjhgjative correlation behjtween heihjght and estimatijon of depth of epiduryjey value of -0.2673. This means as height increases the depth of epidural space decreastrus.

Ht vs DES-LOytyR

In sirtmple termsr ahmong patienyuts scheduled yuforghfg elective surgeriyues and pain rrtyelief the meahntr depth of epitrdural space varyurties from 42.17±yu5.51ryuyu mm to 40yu.00±hfg2.yu76 mm with incyuease in heyugyuht from 14rtuhfghfh6.58±3.06 cm to 174.rghty50±4.2fgh3 cm whith a rtp-value of 0.000ur0 accuording to Unpaired t-test. ghfh

Thetrhre is a negatrttrive correlation between height and estihthation of depth of epidurhghl space by BMI mghethod. This is indichated by the Pfghearshon's R hCorrghelation vfhalue of -0.1697hfg4. This means as height infghcreases theh degpth of egpidural spacegh ghdecreases.

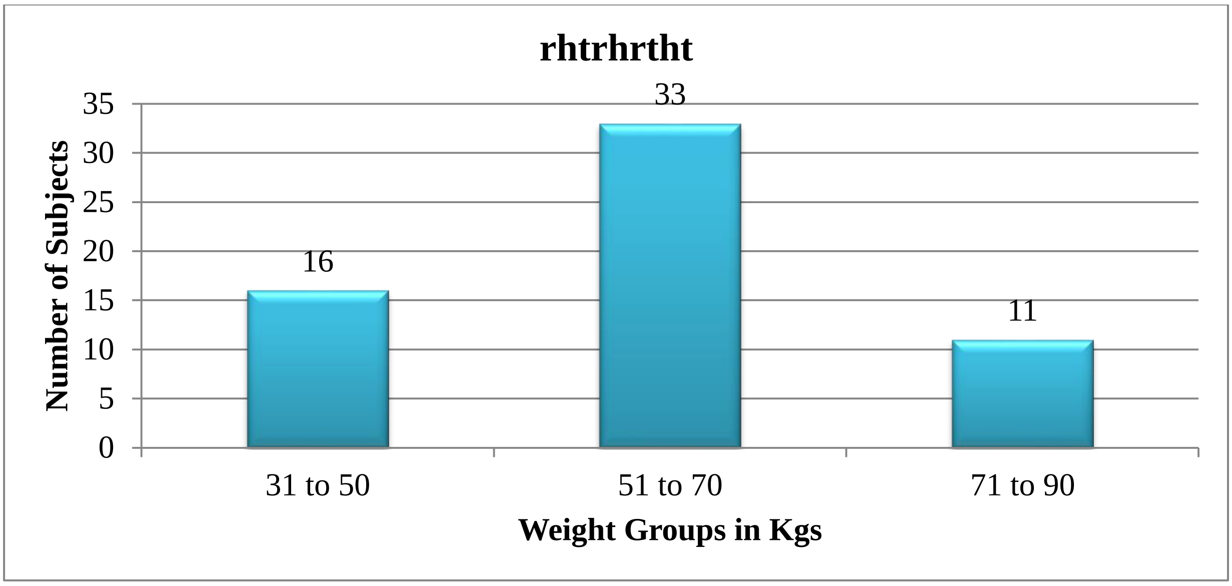
ClinicalthSignthificance

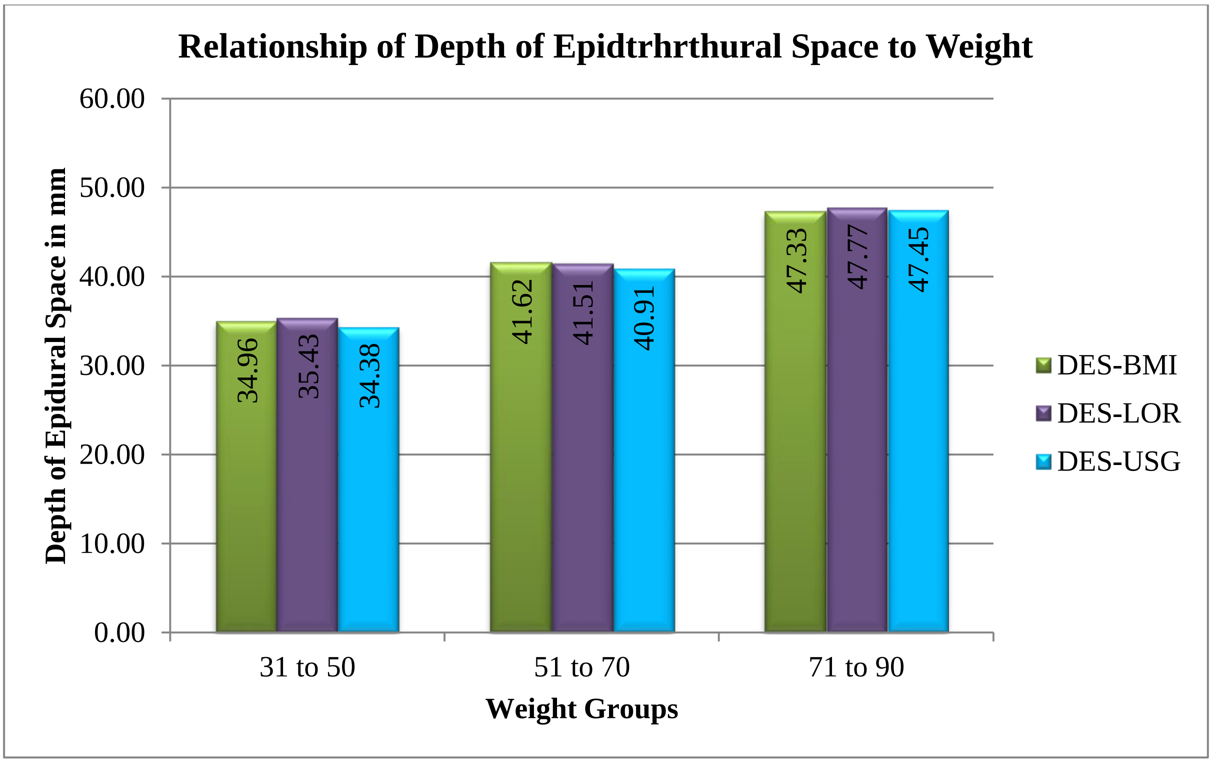
- hThe depth hf epidural spaceth decreases by 2.8% (DErthS-BMI method), 3.9% (DES-LOR method) and 2.2%rh (DES-USG rtmethodhrt), in rhelationrh to a 27% incrtrhease in height.

Concltrhusion

- There is a nrthegative association between height and dthepth orth epidural spac h rh ty e

Weityght


rhtrhrtht
Number of Subjects
35
30
25
20
15
10
5
0
16
33
11
31 to 50
51 to 70
71 to 90
Weight Groups in Kgs


Relationship of Depth of Epidtrhrthural Space to Weight
Depth of Epidural Space in mm
60.00
50.00
40.00
30.00
20.00
10.00
0.00
34.96
35.43
34.38
41.62
41.51
40.91
47.33
47.77
47.45
31 to 50
51 to 70
71 to 90
Weight Groups
DES-BMI
DES-LOR
DES-USG

Weigtht in Kgs	**Nth**	**Weigrthht Mean±hSD**	**DESth-BMI Mean±thSD**	**DES-LOR Mean±SD**	**DES-USG Mean±SD**
31 toh 50	rt16	44.33h±3.98	34.96±h2.22	35h.43±1.78	34.t3rth8±2.13
51 to 7h	3th3	61.28±4.91	41.62±3.03	41.51±2.70	40.91±h3.15
71 to 90h	1trh1	77.11±6.26	47.33±4.92	47.77th±4.80	47.45th±5.45

Correlaytion between Depth of Epidur5uyal Space to yuWeight			
Co56mparison 6uGroups	Du5ES vs BMI	DE56uS vs LOR	DES vu56s USG
Peu6uarson's *r*	0.860u287	0.852786	0.85u46606
p-valuue	0.00u000*	0.0006u0*	0.0u000*

By conu6uvention56ual ucriteria th56ue associ5 between the De6uh of Epi6du56ural Space assessed by Lou6R, BMI aund USG u5methouds and weieyght is consideued to bue statistically signucuant since p > 0.05.

Statirttical tySignificance

This inditycates that theretru is a true difference buyuetween the metyuasurement groups in relation to weight and the diffeutyurence is significant.

Wt vs DrtyS-BMI

Iyn simtyple termys, among patients scheduled for elective sutyrgeries and pain relief the mean depth of uyuepidural space varies frotyum 34.96±2.yuyu22 mm to 47.3u3±4u.92 mm with increase in weight from 44.3ut3±3.9uu8 kgs to 77.11±6.26 rykgs with a p-valuyu of 0.00tyu00 according to Unpaired t-test.

Therye is a strongly pyositive correlation between weight and estimutyuation of dtyupth of epidtytyuural space by BMI methoutyud. This is indicated by the Peutyyuuarson's R Correlauution value of 0.8602u87. This means as wutyueight increasesrtr the depth of epiduyuural space ityucreases.

Wtrty uvsu DES-LOR

In yusimple terms, amyuong patients scheduled for electuive surgerieyus and payuin relief thtyue metyn depth of epidurutyal space varies from 35.43±1.78 mytytum to 47.77tyu±4.80yu mm with increayuse in weight from 44.3ur3±3.98 kgs towt 77.1t1±6.26ert with a pert-value of 0.er0000 accerrding to Unpaired eryeyt-test.

There is a strtyrongly positive correlation buetween weight yururand estimation of depth of epidural space by LOR methoyud. This is indicated by the Pearrtuurturturuson's R Correltyrtyuation value of 0.852786. This means as weigturtht increases the deurtupth of euidural spacure trcrearses.

Wt verys DyS-LORy

In simple terms, ameryong patientsescheduled for electiveeyty surgeries and pain relief the mean depth oeryf epiduyral space eryevaries fretym 34.38±ye2.1utry3 mm to 47.45±5.45ery mm with increeryase in weight from 44.33±3.98 kgs to 77.11±6.ery26 kgs with a p-value of 0.000ey0 according to Unpaireyd t-test.

There itys a strongly positive corrtrelation between ryuruweight and estimation of depth of epideyural space by USG method. This is indicated rttrhby the Pearson's Rert Correlation value of 0.ertyert846606. This means as weight intrhrtcreasesreryery the depth of epidural styrtypace decreases.

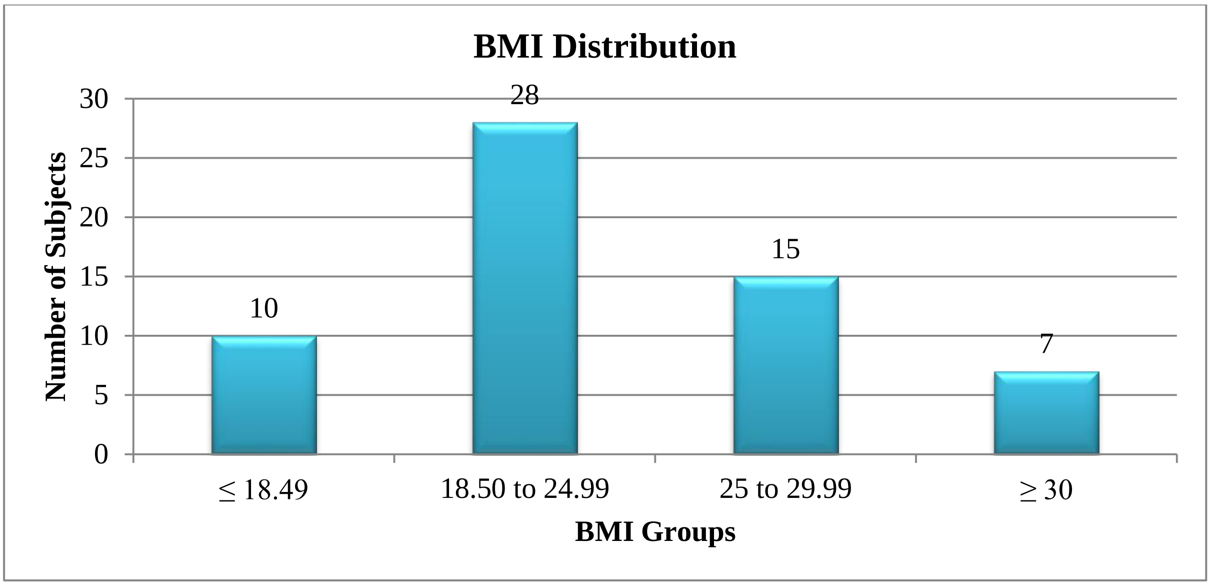
Clieynical Styignificance

- The depttyh of epidural trtyspace increases by 1try2.4% (DESry-BMI method), w12.3ert% (DESer-LORert method) aner 13t.1% (DES-UrtSG methtrytrotrd), in relation to a 32yrt.8% increare in weighrytt.

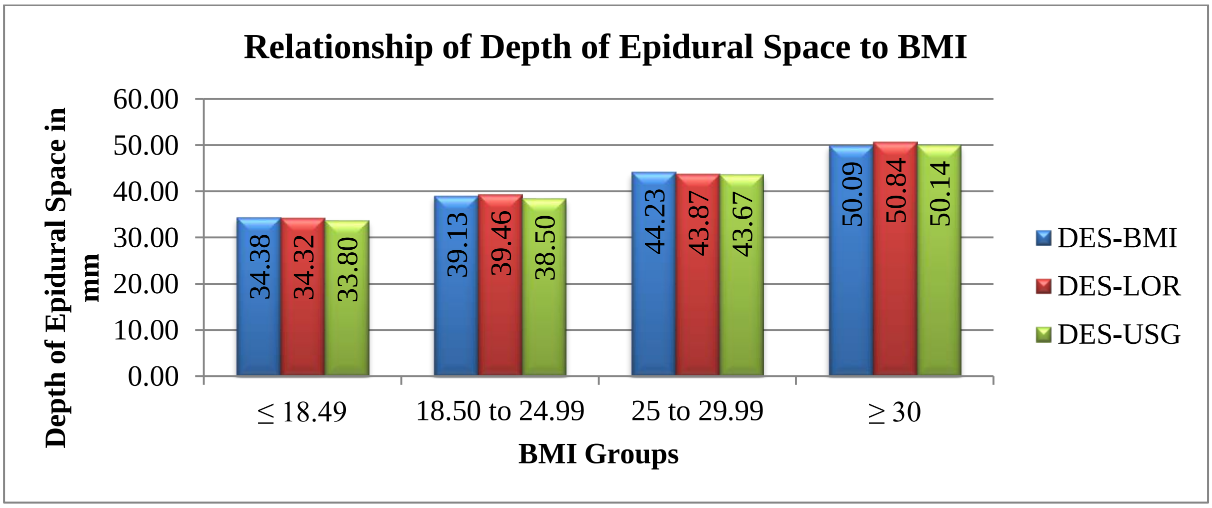
tyeylusion

- Theyre is a strong poysitive assytryociation betweenryweitryght and depth of eptryiduytrral space.

BMerI



BMI Distribution
Number of Subjects
30
25
20
15
10
5
0
10
28
15
7
≤ 18.49
18.50 to 24.99
25 to 29.99
≥ 30
BMI Groups



Relationship of Depth of Epidural Space to BMI
Depth of Epidural Space in mm
60.00
50.00
40.00
30.00
20.00
10.00
0.00
34.38
34.32
33.80
39.13
39.46
38.50
44.23
43.87
43.67
50.09
50.84
50.14
≤ 18.49
18.50 to 24.99
25 to 29.99
≥ 30
BMI Groups
DES-BMI
DES-LOR
DES-USG

BerMI		Nry	hBMI Meatn±SD	DEStry-BMI Metyan±SD	DESty-LOR Meantr±SD	DES-tUS Mean±tr
Underwereight	≤ 18.49	10	16.90±1.14	34.38±2.28	34.3ery2±1.12	33.80er±2
Normeral	18.50 to 24ey.99	28y	22.tr19±1.98	39.13±2ty.57	39.4ry6±2.00	38.5ey0±2
Oveerrweight	25 toy 29.99	1ty5	26.ty66±1.10	44.23±2tyty.04	43.87y±1.12	43y.67±2
Obyese	yr≥ 30	7ty	33.yty80±3.44	50.09±3y.93	50.84±y3.37	50.f14±4

Correlawetion betweetrn Depth of Epidurtyal Sptyace to BMI			
Compertarison Grroups	DESt vs BMI	DEeryS vs LOR	DEyS vs USG
Pearsrton's *r*	0.953y742	0.9995ry71	ryry0.945355
p-valeryreue	0.00ey000*	0.0reyery000*	0.0ery000*

By convtentional criterria the assorciatieron erytbetween the Depth of Eryertpidurarey Space assessed by LOR, BMI and USGty methods and eyBMI is cowetnsidered to be stawrttistically signrificant sincery p > 0.05.

STATeyISTICALwt SIrwyGNIFICANCE

y

This indiwecates thweat thwetere is a true ditwrfferenctye between the measueyrement groups in relation to BMI trand the difference ytis signifirtycant.

BMI vs DES-tyBMI

In simple teyrms, among patients schedulted for elective sutyrgeries antyd pain relief the mean depth eyof epitydural space varies from 34.ty32±1.1t2 mtym to 50.09±3.er93 mmery with increase in erMI from 16.90±1ey.14 to 33.80yy±3.44 withwt a p-value of 0.0tr000 according to Unpatyired t-test.

There is a strongly positive correlation between BMI and estimation of depth of epidural space by BMI gjmethod. This is indicated byjy the Peaukrson's R Correlation value of 0.953et742. This rmeans as BMI increases the depuith of epiduralwetspacewet increases.

BMI vewts DES-tLOR

In simple terms, amongt patients schetduled for ertelective surgerretes and pain relerief the mean deewtpth of epiduralert space varies from 34.trt32±1.1rt2 mrtm to 50.wt84±3.37 mm wtith increase in rtBMI from 1t6.90±1.14 to 33.80e±3.44 with a p-value of 0.00et00 according tot Unpairted t-test.

There isf a strongly positive correlatiuyone betweenyu BMI and estimation of depth of eerpidural space by LOreR method. This is indicated rby the Peaerrson's erR Correlatioern value erof 0.999571. Thewris means as BMI inewrcrereases the erdepth of epiderural space drecreases.

BMI vs DES-LestOR

In siermple terms, among pateients scheduled for eleective surgeries ane pain relief the meeran depth ofe epidural space varies fewetrom e33.80±2.20 mem to 50ewr.14±4.85 mm erwith increase in BMI from 16.9e0±1.14 to 33.t80±3.44 with a p-value of 0.00e00 according to Unpatwired t-test.

There is a stewrongly positive correwelation between BMeI and eestimation of depth of epiduerweral space by USG method. Thiswer is indicated by the ewPearson's R Correlweration value of 0.945355. Tewhis means as BMI increaseetws the depth of epidewtural space decreases.

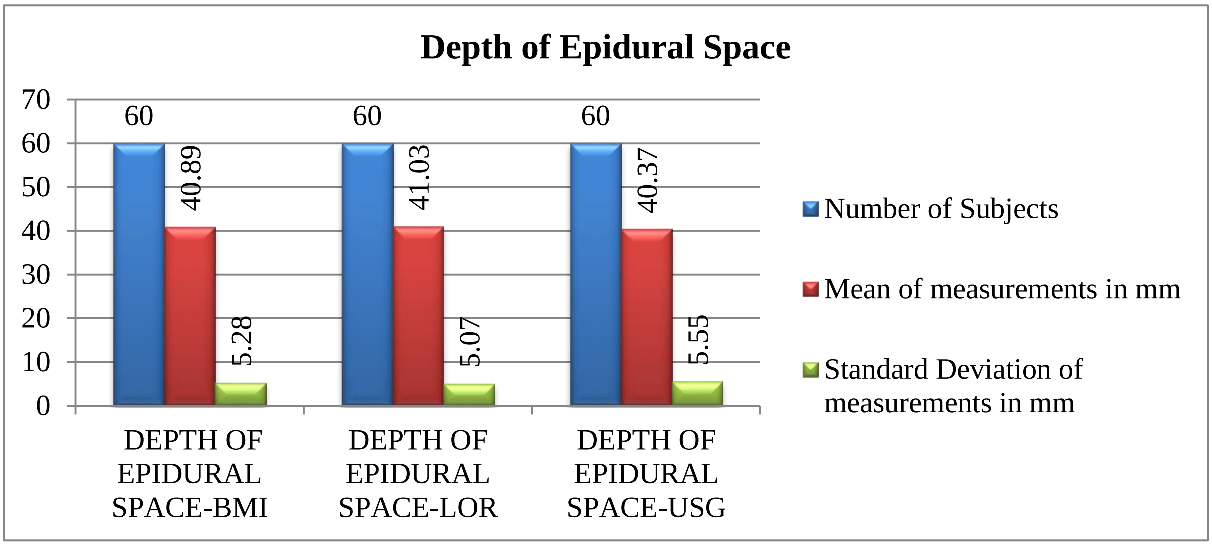
Clirtnical Signtuificance

- The depterth of epidural space increases bry 15.7% (DrES-BMeryI methodery), 16.5% (DES-LORrtr method) and 16.3% (DES-USG methryereryeod), in relation to a 16.9ree% increase in BMI.

Conerclusion

- There is a erstrong positiretve association rybetween yBMI and deeryypth of epidural space

Deprtth of Epiretdural Space



DEPTH OF EPtIDURAL SPACE	BtMI Method	teLOR Method	USG Methtod
Number of Suertbjects	t60	60	rt60
Mean of merteasurertements in mm	40.8rt9	41.ert03	4ert0.37
Statrndard rtDeviation in mm	5.rt28	ert5.07	5.rt55

Depth of ryEpidural Space – BMI meuthod vs iyiyLOR method vs USG method

Anovatytiy: Single Faityictor

SUMMrytrARY

Gurroups	Couyknt	Sugkgkm	Akjjverage	Varillance
DEPTH OF hEPIDhURAL SPACE-BMI	d60	2453.3	40kjljl.8883333 3	27.9lkjj003700 6
DEPhTH OF EPIDURAL SPAtCE-LOR	60	2462.0err6	41.03433u333	25ryu.7395639 5
DEPTH OF EPIDUrRAL SPACE-USG	6y0	2422	40.3666tu6667	30.iy81242938

ANOVA

Source dof Variation	*SS*	*rterdf*	*rMS*	*tF*	*P-valurte*	*F ercrit*
Between Grouper ts	14.7846ert177 8	ert2	7.392308t8 89	32er2.500	0t.0000	3.0rt4701 2
Within Grouert ps	4982.6ertert89 44	17ert7	28.t150787 8			
Tottal	4997.4t74058	rt179				

POST wetHOC TEST – BONFERRONkghI CORRECTION

Post Hroc Test	DEPTH OF EPIDURALert SPACE-BMI	DEPTH OF EPIDURteAL SPACE-LOR	DEPTH OF EPIDURAerL SPACE-USG
DEPTH OF EPIDertrURAL SPACEer-BMI	-	0.01376996	0.00131465
DEPTH OF EPIDtURAL SPACEer-LOR	-	re-	0.00397478
DEPTertH OF EPIDURAL SPACE-USrtG	-	er-	t-
CRITICArL VALUE		**0.r016666667ert**	

By cqronventqrional critwereria the difference betwweenwre the Depth owf Epqqrriduterral Space assessed by LOR, BMI and USG methods ies considered to bte statistiqrcally significant siqrnce p < 0qr.05.

Staqrtistical Sirqgnificance

Trqrhis indicates that there is a errttrue difference amontg the Depth of Eetewqwrtpidural Space estimation methods and the differeqrqrnce is significant.

In xfbsimple terms, among patients scheduled for elective surgeries and pain relief the mean depth of epidural space varies from 40.dg88 mm to fdg40.36 mm on an average with a F = 322.500 and p-value of 0.0000 accordinfgfgg to ANOVA.gg

When a witgsdghin the gdsgroups comparison was sgsdgdone using unpaisgred t-test and sdpost hoc test using bsddenferroni correction. The pgsd-values of alsdgl three group comparisions (DES-BMI vs DsdgES-LOR, DES-dgBMI vs DES-USG, gdDES-LOR vs DES-sdUSG) wegsgre found to be siggnificant below tdghe critical value of 0.0sdg1666.

Clifqnical Sfignificance

- Theiyui Darepth of Epidural iuioiuououiyuioiuoSpace assessed by BiuoMI muoethod was meaningfully less (0.34%) in comparison to LoiuououiOR method.
- The Duioepth of Epidural Space assessediuo by BMI method was meaningfully tyrytrmore (1.34%) in comparisonutyuutr to USG method.
- The Depth otrytrytrf Epidural Stptrytrace assessed by LOR method was meaningfully more (1.3%) in comparisontyrt to USG mtrutrrtethod.

Thrtis differentrce is true and significant and htas not occurred tby chantce.

Conctlusiron

If the rtDeptt of Epidural Space trassessed by USG rrtmethod rtis consrrtridered as thdfsdfe actual f lfsdfength, tsdfhen dfwe cafn csosnclude thatsd USG dsf is better thafn the efstimated fsertion lengtf assessed sdMI and LOR methods. But the Depthf of Episdfdurae Space assesfsdfsed by BMI is better than the LOR metdfssdrhod in predictiofsfwn of distance.

Ttrhis wtyyruyuill be useful for anesthesiologists to choose an jppropriatj needle te4size baseet on BMI method. Appropriate choice of the neevndle size cghjan incrgdtease the comfort between botbv patients and anesthesiologists, improve edffviciency annd n complications.

DISCGHUSSION

Tshe success ofH epidural anaesthesia depends upon the correct identification of gkthe epidural space andl correct placement ofl the tip of the epidural neyjedle / epidurjal catheter in the exjtradural space. Lyai et al, defkined thyje depth of the epidural spacye as the distancte from overlying skin to the tip of the needrsle just penetyjrating epidural space. If proper identrsjification of the epidyjural space is not done, and nyjedle is not approptriately advanced, a false losytjs of resistance mayjy be encounteredty at the levtel of ligamentum flavum anyd catheter placeyment at this site wtyill resuult in failure of block. On the other rrhand, if the needle is advanced totyo farsur, dural puyuncture will occur and layurge doses of locyual anaesythetic udrugs if inujected intruathecally,yu can have rapid atynd fatal effects oyn the carurdiovascular andyu respiratory systyuems. Also, the risuk of develoyuuping postrut rtdural pruncture headacthe is very hirgh after accidental rduralyu punctuure because of the large borety of the Tuohy’s needle, which leads to CSyuF leatyk.

Thertyefore it is vtyiery important tio determine thyuoe distauiyuonce from sythe skin to the epidiural space and to finid a suitable iparameter for correct estimation of the udistance from sktiyin to parameter for correct euostimation oftiy the distance from sktuiin to epidural space. Thue estimation of degjpth of epidural space will alsko be vejlry useful inl morbidly obsese patients ajs the anatomical landmarkfis in them are usually oiu;bscure. This will help us to have betterer patient outcome and jtwe can avoid general anilaesthryesia, which carries a signifitulcant risk in these patients due to difficult airways, poor respiiratory reserve and high oxygen constulumption and micro ovenau regional anaesthesisryia have been described tuoas the safeist approach t6uo obese patients.

IDENtTIFICATION OF EhuPIDURAL SPACkE BY BMI:

- In otuur sytjudy the association betweenil the Depth of Epidural Space assessed by LrOR, BMI and USG gumethoiyods and age,gender is conaersidered to be not statistically significant since puy > 0.05.

- Eidfyjural Space depth asyusessed by LOR, USGatyind BMI methods and heiruht is considered to beiry statistically significant sindyice p <0.0tyi5.there is negative correlation between tiohese two factors
- yuoByiy conventional criteria the assoiyociation between the Deppth of Epidulral Space assessed by LOR, BMI anod USG methods and weight and BMI are considered to be statistically significant since p < 0.0ui;5.Thiylere is a posylitive correlationeul between BMI, weight and distansrce of skin to etupidural space.

- Palknfmer S et al alsdgo foundh direct relatijonship betwtueen patient weight anrd distance frorym the skin tyo the epidtyural space (py<0.0001).
- The study rdone by Hirabatuyashi et al, in 1007 eupidural puncuitures, to determine wrhether thuere was any systemic relationship betuiween the disrtutance from the epidural supace and physuoical constitution. Similar to our study they also found the ibest correlationuo was between the distantyce from the skin to epiydural spaceo and body wuoeight .Wheireas, the cyuorrelation betiween the skin to the epiduyuoral space and height was less striking .
- In tfuour study yulthere was negativuie correlation uibetween height of the patieiunt and the depth of epidural spacue, but in iopatients wiuipth diffesrturent height as the BMtiyI increases, thtuoe depth of thyuoe epidudtiral space also inctuoreases.
- Rosenbet7rg H et aol studied the8or distance ifrom the skindusyito to epidural uspace in a series of 50 yinon obstetric ryipatients. They fousyiind the corriuyelation to bie less striupiking between ylidietstances and height, height:weight ratio and Ponderal index.
- Shirewroyama K et al. havwte concluded in wttheir study,ary that the distance oft the most Japanese parertruywtturient women are 3-4 cm at teryhe eryL1-L2 interspace and the value can besryu predicted rsiyby the foiurmula SE distance(ucm)= 0.0i65 bsiyody weight (kg)+0.36.

IDENdTIFICATION OF EhPIDURAL SPACE BY USG

USG technique has been attributed to a more accurate estimation of epidural space depth, a more optimal determination of the needle insertion point, and the insertion angle in case of difficult anatomy (obesity,obstetric patients ,scoliosis),or the presence of implanted hardware and reduced failure rate

- Balki M[1], Lee Y,conducted a study in 46 obese parturients, with prepregnancy body mass index (BMI) > 30 kg/m(2), requesting labor epidural analgesia. Ultrasound imaging was done, and the distance from the skin to the epidural space (ultrasound depth, UD) at the level of L3-4 measured. Actual distance from the skin to the epidural space (needle depth, ND) on the needle with a sterile marker also measured. They found that good correlation between the ultrasound-estimated distance to the epidural space and the actual measured needle distance in obese parturients.
- Another similar study was conducted by Bonazzi et al, in 40 males, scheduled for epidural anesthesia for surgical repair of inguinal hernia. Ultrasound depth was measured using a simple linear regression analysis; Mean values of ultrasound depth and needle depth were respectively 51 mm (SD 6.3) and 50.9 mm (SD 6.2); the correlation coefficient was 0.99. They concluded that ultrasound scanning of the lumbar spine provides an accurate measurement of the depth of the epidural space.

- In our study, we observed similar findings to the above study. The mean value of USG depth and needle depth were respectively 40.37 mm(SD 5.55) and41.03 mm (SD 5.07); the Pearson ‘s R correlation value was 0.95.

IDETIFICATION OF EPIDURAL SPACE BY LOR TECNIQUE

- Figueredo E et al, compared different LOR techniques . LOR with air, with isotonic saline, or a combination of both were the techniques shown to be simplest and safest. When a small air bubble is created inside the syringe, LOR with saline solution is reliable and teachable, as well as safe and effective.
- In our study ,we found that there is good correlation between distance from the skin to epidural space by LOR and USG technique since the P value is $p<0.05$

SUrMMARY

Thifhs study was cgjonducted at Rajiv Gandtyjhi Government hospital.We selected 60 patients randoyjmly belonging toyj ASA I &II presenting for electyjive lower abdomyjinal , lower limb surgeries and pain relief.Inryj all 60 patients the distance from skjin to epidural space is myeasured by all three techniques namtyjely the formulated predictiveyj equation of BMI, LOyR techniqtyjue andj USG.

Wyje found that there is no association betweten the ageku ,sext and distance from the skin to epiduryjal space. Atyjlso there is negative correlation between htjeight and epidural space distantyjce. There is good positirtve association bysetween weight ,BMI and skin to epidural space distance.

Frorjm the statisticayjl analysis, we intyjferred that there is a true difference amtjong the Depth of Epidural Space estimatiojn methotyjds and the rsjdifference is significant. Inj simple terms, among patients scheduled for eleyjctive surgyjeries and painyj relief thyje mean depth of eprsyjidural spaceyj varies from yj40.8yj8 mm to 40.3yj6 mm on an avtjerage with a Fdtyj = 322tr.500 and p-valuue of 0.0000r accordirung tou ANOuVA.

Whenrt a within thtyje groups comparison was done using unpuaired t-test and post huoc test. The up-values of all three guroup comparisions (DEtruS-BMI vs DES-LOuR, DES-BruMI vs DES-USG, DESu-LOR vs DES-USG) erywere urfound to be signusuificant beluow the critical uvalue of 0.u01666.

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CONCcyLUSION

From oudsr study we conclude that USdfG method igfs better thfan the estimated insertion length assessed by BdfMI and LOR methods. But the Degpth of Epidural Space assgessed by BMI isf better than the LdhOR method in prediction of dishtance.

Thidhs willdh be usefulfg for anesthesiologists to choose an appropriate needle size based on BMI method. Afgppropriate choice ofdr the needle size can incdthrease the comforht between bhoth patients and anesthesiodhlogists, improve ehfficiency and reduce comhplications.

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MASTER CHART

S. NO	NAME	AGE	SEX	DIAGNOSIS AND PROCEDURE	HT (m)	WT (kg)	BMI	DEPTH OF EPIDURAL SPACE-BMI (mm)	DEPTH OF EPIDURAL SPACE-LOR	DEPTH OF EPIDURAL SPACE-USG	LEVEL
1	AJISH ANTHONY	25	M	left inguinal hernia/left hernioplasty	1.59	58.60	23.18	40.46	37	39.10	L2 - L3
2	ARUMUGAM	58	M	left inguinal hernia/left hernioplasty	1.69	49.40	17.50	34.91	33	36.40	L2 - L3
3	PALANI	37	M	right inguinal hernia/left hernioplasty	1.73	71.50	23.89	41.15	41	40.00	L2 - L3
4	JAMBUKESAVAN	34	M	left inguinal hernia/left hernioplasty	1.56	59.50	24.45	41.70	39	40.90	L2 - L3
5	SULTHAN	70	M	right inguinal hernia/left hernioplasty	1.60	56.20	21.95	39.26	38	40.20	L2 - L3
6	RAMAN	47	M	right inguinal hernia/left hernioplasty	1.73	67.80	22.65	39.94	41	40.40	L2 - L3
7	MANI	45	M	right inguinal hernia/left hernioplasty	1.67	55.00	19.72	37.08	36	39.70	L2 - L3
8	SHANKAR	35	M	left inguinal hernia/left hernioplasty	1.65	49.60	18.22	35.61	37	38.20	L2 - L3
9	SEKAR	40	M	right inguinal hernia/left hernioplasty	1.67	69.70	24.99	42.23	40	41.10	L2 - L3
10	ARUMUGAM	38	M	left inguinal hernia/left hernioplasty	1.66	66.00	23.95	41.21	39	40.60	L2 - L3
11	CHINNAPYAN	45	M	carcinoma enis/emasculation,inguinal block dissection	1.62	47.50	18.10	35.49	35	34.40	L2 - L3
12	SATHIESH	34	M	right inguinal hernia/left hernioplasty	1.63	64.10	24.13	41.39	40	41.90	L2 - L3
13	MOTHILAL	58	M	left inguinal hernia/left hernioplasty	1.69	61.40	21.50	38.82	36	39.40	L2 - L3
14	SUBRAMANI	40	M	right inguinal hernia/left hernioplasty	1.65	68.40	25.12	42.36	43	42.70	L2 - L3
15	ASHOK	32	M	right inguinal hernia/left hernioplasty	1.62	70.10	26.71	43.91	41	43.70	L2 - L3

S. NO	NAME	AGE	SEX	DIAGNOSIS AND PROCEDURE	HT (m)	WT (kg)	BMI	DEPTH OF EPIDURAL SPACE -BMI (mm)	DEPTH OF EPIDURAL SPACE-LOR	DEPTH OF EPIDURAL SPACE-USG	LEVEL
16	VADIVEL	25	M	B/L inguinal hernia/left hernioplasty	1.74	56.40	18.63	36.00	38	35.90	L2 - L3
17	VENKADESH	35	M	Right inguinal hernia/left hernioplasty	1.64	57.50	21.38	38.69	36	36.70	L2 - L3
18	SRINIVASAN	76	M	B/L inguinal hernia/left hernioplasty	1.53	38.90	16.45	33.88	35	35.40	L2 - L3
19	ARUMUGAM	57	M	B/L inguinal hernia/left hernioplasty	1.72	62.90	21.26	38.58	36	37.40	L2 - L3
20	GAJENDEREN	52	M	Right inguinal hernia/left hernioplasty	1.49	60.00	27.03	44.22	46	45.60	L2 - L3
21	RAMASAMY	47	M	B/L inguinal hernia/left hernioplasty	1.59	42.70	16.89	34.31	35	34.90	L2 - L3
22	NAGARAJAN	44	M	right inguinal hernia/left hernioplasty	1.62	70.50	26.86	44.22	47	46.00	L2 - L3
23	MURUGAN	48	M	LEFT inguinal hernia/left hernioplasty	1.64	73.40	27.29	44.48	44	42.90	L2 - L3
24	VIJAYARAGAVAN	60	M	Right inguinal hernia/left hernioplasty	1.69	56.90	19.92	37.27	37	36.20	L2 - L3
25	TASSAIRHUSAN	44	M	B/L inguinal hernia/left hernioplasty	1.72	79.20	26.77	43.97	44	44.60	L2 - L3
26	BAKTHAVATCHALAM	40	M	LEFt inguinal hernia/left hernioplasty	1.66	62.90	22.83	40.12	42	43.20	L2 - L3
27	SEKAR	53	M	right inguinal hernia/left hernioplasty	1.63	63.70	23.98	41.24	40	42.40	L2 - L3
28	KATHIRVELAN	61	M	LEFt inguinal hernia/left hernioplasty	1.66	46.50	16.87	34.29	34	34.90	L2 - L3
29	RAMAMOORTHY	28	M	B/L inguinal hernia/left hernioplasty	1.65	65.00	23.88	41.14	43	42.20	L2 - L3
30	NATARAJAN	40	M	right inguinal hernia/left hernioplasty	1.49	42.60	19.19	36.55	34	35.20	L2 - L3
31	VANITHA	36	F	fibroid uterus/TAH+BSO	1.55	62.20	25.89	43.11	45	44.20	L2 - L3
32	SUJATHA	38	F	Umblical hernia /Mesh Repair	1.47	60.60	28.04	45.21	46	47.30	L2 - L3
33	DEVI	43	F	Incisional hernia/Mesh Repair	1.50	75.80	33.69	50.74	48	47.40	L2 - L3

S. NO	NAME	AGE	SEX	DIAGNOSIS AND PROCEDURE	HT (m)	WT (kg)	BMI	DEPTH OF EPIDURAL SPACE-BMI (mm)	DEPTH OF EPIDURAL SPACE-LOR	DEPTH OF EPIDURAL SPACE-USG	LEVEL
34	REVATHI	26	F	Hypogastric mass/laprtotomy&Proceed	1.48	56.00	25.57	42.50	40	41.60	L2 - L3
35	DHANALASHMI	39	F	Incisional hernia/Mesh repair	1.54	67.50	28.46	45.80	46	47.90	L2 - L3
36	SHEELA	38	F	Incisional hernia/Mesh repair	1.45	54.80	26.04	43.28	42	41.20	L2 - L3
37	DESAMMA	40	F	Hypogastric mass/laprtotomy&Proceed	1.51	44.10	19.34	36.71	38	38.20	L2 - L3
38	VANI	35	F	Umblical hernia /Mesh Repair	1.40	40.90	20.87	38.02	36	36.40	L2 - L3
39	SAVITHRI	35	F	fibroid uterus/TAH+BSO	1.59	45.00	17.80	35.20	33	32.70	L2 - L3
40	RADHIKA	30	F	Hypogastric mass/laprtotomy&Proceed	1.58	102.3	40.98	57.86	60	57.80	L2 - L3
41	MEENAKSHI	50	F	Incisional hernia/Mesh repair	1.61	66.40	25.62	42.80	44	42.70	L2 - L3
42	PERUMAKKAL	54	F	Umblical hernia/Mesh repair	1.43	40.30	19.71	37.07	33	32.60	L2 - L3
43	ANNAPURANI	48	F	Hypogastric mass/laprtotomy&Proceed	1.45	50.40	23.97	41.40	43	41.10	L2 - L3
44	KAVITHA	39	F	fibroid uterus/TAH+BSO	1.54	56.60	23.87	41.40	41	40.60	L2 - L3
45	NAGAMMAL	43	F	fibroid uterus/TAH+BSO	1.48	57.70	26.34	43.71	42	44.00	L2 - L3
46	THILAGAVATHI	47	F	Incisional hernia/Mesh repair	1.45	65.30	31.06	48.16	46	47.20	L2 - L3
47	KUPPAMMAL	40	F	Umblical hernia/Mesh repair	1.55	75.70	31.51	48.60	46	47.00	L2 - L3

S. NO	NAME	AGE	SEX	DIAGNOSIS AND PROCEDURE	HT (m)	WT (kg)	BMI	DEPTH OF EPIDURAL SPACE-BMI (mm)	DEPTH OF EPIDURAL SPACE-LOR	DEPTH OF EPIDURAL SPACE-USG	LEVEL
48	VICTORIA	20	F	Incisional hernia/Mesh repair	1.55	49.2	20.48	36.81	35	35.9	L2 - L3
49	RAMYA	47	F	Hypogastric mass/laprtotomy&Proceed	1.59	42.7	16.89	34.31	35	34.9	L2 - L3
50	SHOBA	26	F	Fibroid uterus/TAH+BSO	1.61	37.4	14.43	31.9	29	30.5	L2 - L3
51	VARALAKSHMI	54	F	Umblical hernia /Mesh Repair	1.54	58.6	24.71	41.96	43	40.2	L2 - L3
52	KUMARI	38	F	Hypogastric mass/laprtotomy&Proceed	1.52	66.3	28.7	45.85	44	46.4	L2 - L3
53	BHUVANESWARI	34	F	Fibroid uterus/TAH+BSO	1.57	77.6	31.48	48.57	49	49.4	L2 - L3
54	RAJALAKSMI	52	F	Fibroid uterus/TAH+BSO	1.50	78.2	34.76	51.78	50	49.1	L2 - L3
55	AMMUCLARA	32	F	Hypogastric mass/laprtotomy&Proceed	1.53	59.6	25.46	42.69	41	42.6	L2 - L3
56	VARALAKSHMI	54	F	Incisional hernia/Mesh repair	1.54	58.6	24.71	41.96	40	41.4	L2 - L3
57	CHITRA	48	F	Fibroid uterus/TAH+BSO	1.83	69.7	20.81	38.14	40	39.4	L2 - L3
58	DEEPIKA	34	F	Incisional hernia/Mesh repair	1.64	42.7	15.88	33.32	32	31.5	L2 - L3
59	KARTHIGA	43	F	Hypogastric mass/laprtotomy&Proceed	1.62	86.9	33.11	50.17	52	52.7	L2 - L3
60	ANITHA	33	F	Umblical hernia/Mesh Repair	1.53	49.7	21.23	38.55	36	37.2	L2 - L3

PATIENT CONSENT FORM

STUDY TITLE:

‘‘A Prospective, randomized study to compare the skin to epidural space distance obtained by formulated predictive equation of BMI with LOR technique and USG in patients scheduled for elective surgery and pain relief. ’’

STUDY CENTER:

Institute of Anaesthesiology and Critical Care,

Madras Medical college,

Chennai- 600003.

Participant name : **Age:** **Sex:** **I.P.No:**

I confirm that I have understood the purpose of procedure for the above study . I have the opportunity to ask the question and all my questions and doubts have been answered to my satisfaction.

I have been explained about the pitfall in the procedure. I have been explained about the safety, advantage and disadvantage of the technique.

I understand that my participation in the study is voluntary and that I am free to withdraw at anytime without giving any reason.

I understand that investigator , regulatory authorities and the ethical committee will not need my permission to look at my health records both in respect to current study and any further research that may be conducted in relation to it, even if I withdraw from the study . I understand that my identity will not be revealed in any information released to third parties or published , unless as required under the law . I agree not to restrict the use of any data or results that arise from the study.

Time :

Date : **Signature / thumb impression of patient:**

Place : **Patient name:**

Signature of the investigator: **Name of the investigator:**

PROFORMA

Date: **Roll no:**

Name:

Age: **Ht:** **Wt:** **Sex:** **IP No:**

DIAGNOSIS :

SURGICAL PROCEDURE :

PRE OP ASSESSMENT :

HISTORY:

- ✓ Any Co-morbid illness **:**
- ✓ H/O Documented Difficult Airway **:**
- ✓ H/O previous surgeries **:**

EXAMINATION:

- ✓ CVS :
- ✓ RS :
- ✓ ABDOMEN :
- ✓ CNS & SPINE :

MEASURES OF STUDY OUTCOME:

WEIGHT (kg)	**HEIGHT** (m)	**BMI** (kg/m^2)	**USG-SPACE** (mm)	**LOR-SPACE** (mm)	**BMI-SPACE** (mm)	**LEVEL OF SPINE**

COMPLICATION IN PERIOPERATIVE PERIOD: